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OILFIELD EXPLORATION AND EXPLOITATION.

Geology.

326. Disthene-Staurolite Association of Minerals in the Meso-Cenozoic of the South-Emba Oil-Bearing Region. N. A. Shvemberger. Comptes Rend. (Doklady) Acad. Sci. URSS, 1946, 53, 459 (in English).—Previous views on the source of supply of clastic material in the Mesozoic for the South Emba region are revised on the basis of more extensive data on the mineralogical composition of the rocks of the Lower Jurassic, Valanginian, and Cenozoic of the Emba region. The disthene-staurolite association of minerals occurs only in the first two series and it is suggested that during the period in which these series were formed, disthene-bearing clastic material was supplied from the Russian platform, previously studied by Baturin. G. H. B.

327. Distribution of Oceans and Continents. W. G. Woolnough. Bull. Amer. Ass. Petrol. Geol., 1946, 30, 1981.—This paper attempts to reconcile the tetrahedral theory and Wegener's hypothesis regarding the distribution of oceans and continents on the earth's surface. These theories are normally mutually contradictory.

The author suggests that while the tetrahedroid tendency of a contracting and solidifying globe has played a very important part in earth history, its initial stages of development were interfered with and distorted by the early asymmetrical development of the Pacific Ocean basin. It is suggested that Darwin's belief that the Pacific Ocean represents the scar left on the earth by the tidal separation of the moon should be now re-examined. Reasons are given for supposing that such an injury caused a deformity of the embryonic tetrahedron, and that the presence of the Pacific scar caused the displacement of the Antarctic quoin towards South Africa, and twisted the dihedral edges of the tetrahedron, forming the Gondwana continent.

The "traumatic lesion" of the earth is considered more severe in the South Pacific than in the North, resulting in the development of the northern continental masses in the high northern latitudes.

As cooling of the earth progressed, the tetrahedroid tendency developed in deeper zones which were not controlled by the Pacific scar. The roots of the continental masses were carried nearer to the positions of ideal tetrahedroid symmetry.

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It is thought that it was not until the initiation of the Hercynian diastrophism that the "debiscence" of the Gondwanaland knot occurred, initiating the extensive continental drift of the southern continents and India. India has not yet reached its normal tetrahedral position, having been delayed by having had to plough through the thick mass of the south-western Asiatic geosynclinal sediments. In its later movements India has caused the crumpling of the great Himalaya complex of mountains.

South America also has not yet reached its final position in the tetrahedral symmetry. When it does so, it will become exactly antipodal to the Caspian-Turkestan area.

Finally, it is suggested that when the Pacific was produced by moon lesion, the ragged edges of the scar were left and have persisted ever since as a circum-Pacific ring. This ring may have had a profound tectonic effect, and its presence may explain the distribution and limitation of Laramide folding, and the tectonic complexities of the Caribbean, Moluccan, and Falkland Island regions. E. N. T.

Geophysics and Geochemical Prospecting.

328. Recent Trends in Geological-Geophysical Exploration and Methods of Improving Use of Geophysical Data. R. C. Coffin. Bull. Amer. Ass. Petrol. Geol., 1946, 30, 2013.—Statistics are given of the increase of geophysical exploration in recent years. Since 1942, gravimetric methods in the United States have been increased by 200%, seismic methods by 50%, core drilling by 100%, and magnetic surveys by 70%.

In spite of the tremendous increase in the use of the gravity method, which is discussed in detail, there has not been a corresponding increase in the understanding of its proper application and limitations.

It is submitted that a tremendous improvement in geological thought and a more economical use of expensive geophysical data would be made possible by the education of district geologists in geophysical concepts. There is already a tread in this direction, but its acceleration is considered most necessary. E. N. T.

329. Oil-Bearing Basins, Their Facies and Conditions of Accumulation of Source Material for the Formation of Oil. B. V. Weber. Comptes Rend. (Doklady) Acad. Sci. URSS, 1946, 53, 447 (in English).—Some of the geological and hydrochemical conditions necessary for the accumulation of petroleum source materials in potential oilbearings basins and their subsequent conversion into petroleum, are discussed. The most typical feature of such basins is their half-closed nature and they are considered to have been bays divided from the sea by sub-aqueous ridges or reef barriers. The favourable effect of the resulting threshold conditions on the development and accumulation of organic material is described with some present-day examples. The influence of geological and other factors on the subsequent conversion of these accumulations into petroleum is also outlined. G. H. B.

Drilling.

330. Bollard Method for Shallow-Water Drilling. A. J. Tucker. Oil Wkly, 16.9.46, 123 (3), 98.—A bollard, in maritime terminology, is a combination fender and mooring. usually a driven-pile cluster with bitt or cleat on top. In this respect, it describes the protective device around the submerged well-head, which has the companion purpose of serving as pivot point for the ship to retain the rig over the hole. A design is proposed for shallow-water drilling using a bollard. In the design it is envisaged that a landing ship tank is converted for drilling by installing a derrick and requisite machinery on the forecastle head. In the hull, where the bow ramp aperture was located, an alteration has been accomplished so that drilling can be conducted through the bottom of the ship. On deck and abaft the rig, pipe racks have been installed on either side of the centre line to hold drill stem, casing, and spare pipe. Between these racks, the lowdown device travels. Vessel is moored to four buoys on bow and quarter and is sunk on to the ocean floor. The bollard is sunk in position in the drilling chamber and is enclosed within the three walls and the bow doors, thereby serving as pivot point for the ship. Through the bollard, drilling operations are conducted. Certain details of safety measures and of design factors affected by the peculiar conditions of the hydrography of the problems are presented. A. H. N.

331. Large Power-Type Rig in W. Texas Unitized to Facilitate Moving. K. M. Fagin. *Petrol. Engr.*, August 1946, 17 (12), 154.—The rig layout employed for drilling the Humble Oil and Refining Company's Harris No. 1 Well in Sterling County, Texas, is described. Details are given of engine substructures (accompanied by detailed drawings), water system equipment, pipe rack design, and other lesser features.

R. B. S.

332. Improved Wyoming Drilling Technique. C. H. Rankin. Oil Wkly, 9.12.46, **124** (2), 58.—An innovation in drilling introduced in the Rocky Mountain region is that of drilling a full $17\frac{1}{2}$ -in hole for the surface casing without first drilling a pilot hole. In this field the casing programme calls for setting 2500 ft or more of $13\frac{1}{3}$ -in outside diameter surface casing. Conductor, 90–100 ft of 22-in casing, is welded in the derrick and run as a unit. A. H. N.

333. Magnolia Company's Open Gulf Test in Below 8400 ft. Anon. Oil Wkly, 28.10.46, 123 (9), 31-32.—The progress made by the well being drilled in the open waters of the Gulf of Mexico, located 5 miles from the nearest land, is reported. The derrick is on a man-made island forming the substructure. A special feature of the derrick foundation-was the provision for drilling three wells from the one foundation by skidding the derrick substructure forward or backward to two other positions. This was made possible by the use of a special substructure design which transferred all derrick floor loads to corner and side columns of the substructure. The substructure in turn was fastened to an upper skid beam assembly resting on a lower skid beam assembly, which in turn was supported on the steel wide flange beam caps of the steel pile foundation. An upper and lower skid beam assembly combined was made up of six 10-in wide flange 89-lb beams. Caps for the steel piling were 17-in dia $\times 1\frac{1}{2}$ -in base plates welded to the top of each piling and being joined by welding to the wide flange beam caps resting thereon.

Details of material requirements are presented. Communications are by radio.

A. H. N.

334. Diamond Core Bits Give High Recovery. G. M. Wilson. Oil Wkly, 2.12.46, 124 (1), 24-25.-A new type core barrel employing an improved diamond bit cuttinghead is described. It has been used successfully in the Rangely field, Colorado. The diamond bit, placed on the bottom of a 25-ft core barrel, cuts a $6\frac{1}{3}$ -in hole and $3\frac{3}{4}$ -in core. One hundred per cent core recovery has not been uncommon, with 25-ft solid Weber sand cores frequently being taken from the barrel. In one well core recovery was 100%, the average cut/bit being 88 ft, and with coring time averaging 9.6 min/ft. In comparison, a conventional core barrel used on a similar section of the hard sandstone in this well, cored at the rate of about 43 min/ft. Complete and largely unbroken core recovery is attributable to both the design of the diamond core head and to the construction of the barrel, the latter actually consisting of two barrels, one inside the other. The inner barrel, which takes the core, is stationary, while the outer one, to which the diamond core head is attached, is rotated by the drill-pipe. A free-floating ball-bearing race between the top of the inner barrel and outer barrel allows the inner barrel to remain stationary as the core slides into it. The circulating fluid flows around the inner barrel and through water courses in the bit, thus minimizing core flushing. After filling the inner barrel, the bit is pulled off bottom, allowing the split ring core catcher to pull down in a tapered sub above the bit. This action breaks off the core, the latter then being held in the inner barrel for removal to the surface. With the exception of the core barrel and the several special tools and wrenches used in handling it while it is out of the hole, all coring operations are conventional. Drilling mud is the same as that used in coring with conventional barrels. Photographs illustrate the bit. A. H. N.

335. Practical Aspects of Directional Drilling. D. K. Weaver. Oil Gas J., 16.11.46, **45** (28), 263. (Paper presented before A.P.I.)—Directional drilling of rotary holes has become common practice in the oilfields, with recognition of the savings to be made by exploiting additional reserves in locations too costly or inaccessible for vertical drilling. In limited use in the Signal Hill field from about 1927 to 1930, real development of high-angle directional drilling occurred during 1938 with the tapping of the

rich oil pool lying beneath the tidelands off Huntington Beach, Orange County, California. This paper gives the practical side of directional drilling with control methods other than with deflecting tools. A. H. N.

336. Maintenance Procedure in the Field for I.C. Engines. L. Billington. Petrol. Engr, September 1946, 17 (13), 74.—The duties of the travelling mechanic, and the necessary equipment of a travelling workshop for servicing engines in the field are discussed. R. B. S.

337. Warm Worked Casing. J. J. Dunn. *Petrol. Engr*, September 1946, **17** (13), 96. —In processing warm worked casing, the final reduction to size ranging up to some 8%of the diameter is made at a temperature between the blue brittle range and the lower critical temperature. The result is a casing of high transverse compression and longitudinal tension properties. The increased transverse compression strength results in a high collapse resistance and the increased longitudinal tension strength to increased joint strength. Also a wide range of these improved properties is possible by variation of the per cent reduction and temperature.

The theory and development of the process are described in detail and test results are also given. R. B. S.

338. Deeper Drilling Necessitates that Greater Emphasis be Placed on Drill-Pipe Testing. G. Weber. Oil Gas J., 31.8.46, 45 (17), 72.-Drill-pipe defects are of two distinct classes : Those occurring as a result of fabrication, and those resulting from handling, corrosion, or stress in service. Rolled-in scale, laps, seams, and cut plugs appear to have caused some failures in new drill pipe. This is indicated in cases where new drilling strings suffered several early failures, then continued in use through their normal service life without abnormal trouble. At present, steel mills employ careful control over the manufacturing and fabrication processes, followed by visual inspection of the finished product. Such inspection covers dimensional tolerance, concentricity, thread accuracy, and examination of laps and seams. Laps and seams which have opened and the depths of which exceed $12\frac{1}{2}\%$ of wall thickness are rejected. However, such defects which have not yet opened at the mill are often invisible and their depths are unknown without destructive testing. Several non-destructive testing methods are described in the paper for field or shop testing. Magnetic particle inspection and the fluorescent penetrant method are cited as aids to visual inspection, along with automatic testing methods which would indicate defects to be further inspected by skilled personnel. The latter methods involve techniques based on a number of principles, including surface magnetic field measurement, diffraction or back reflection of gamma rays and X-rays, hysteresis and eddy current losses, and conduction of heat, electric currents, vibrations, supersonic waves, X-rays, and other radiations. In addition to the regular inspection methods now in use, the adoption of a low-cost visual inspection aid such as Magnaflux or Zyglo is suggested. Either of these commercial methods, could be employed in inspecting about one in every hundred joints of pipe passed by regular inspection. The new method could also be used in further study of joints rejected by the initial visual inspection, followed by grinding down or sectioning of defective areas and complete cataloguing for future reference and analysis. Subject to determination of actual effect of each type of mill defect on service life, automatic scanning devices are suggested as possible important supplements to visual inspection in the future. A. H. N.

339. Surface Preparation and Drill Pipe Fatigue Failure. W. S. Lloyd. *Oil Wkly*, 9.12.46, 124 (2), 46.—Failure of drill pipe by fatigue is recognized and accepted limits for air fatigue for materials are set; corrosion fatigue is more difficult to specify as it depends on the conditions under which it obtains. Under conditions of combined corrosion and fatigue, failure has been found to occur at much lower stress than for plain fatigue or notch fatigue in the absence of corrosion. Various methods, mainly by coatings both metallic and non-metallic, have been tried to combat the effect of corrosion. The usage drill pipe encounters, while not prohibiting such coatings, does make them of less value than for other types of material. Besides the use of coatings the effect of surface finish has also come under consideration, and arguments have been proposed in the field that a surface finish different from mill-scaled finish would be

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beneficial. Since surface finish is more applicable to drill pipe than coatings, this factor was investigated both for air fatigue resistance and corrosion-fatigue. The experiments undertaken and their results are described. The corrosion-fatigue results are quite different from the air fatigue. Here it is clearly shown that, regardless of type of surface treatment within the limits of test error, there is no difference in the behaviour or resistance to combined corrosion and fatigue. Notches are present, whether formed mechanically or chemically, and surface treatment has no effect on notch sensitivity. Where a durable film can be retained under stress encountered in service, such as exhibited by so-called corrosion-resistant or stainless material, the problem becomes more one of plain fatigue than corrosion-fatigue. Also, even though the effects of corrosion are not prevented, of several grades of steel the one having the least notch sensitivity will be the most acceptable for service under conditions of fatigue and corrosion. Unless conditioning increases the length of service of drill pipe to an acceptable expected life, either corrosion-resisting materials or materials having low notch sensitivity may be necessary in certain cases. A. H. N.

340. Selection of I.C. Engines for Field Use. Anon. *Petrol. Engr*, September 1946, 17 (13), 57.—The mathematical and engineering considerations in the selection of engines for hoist and pump duties are outlined and illustrated by simple calculations. The other general considerations which are involved are also discussed. R. B. S.

341. Improvements are Needed for Pumping Compressible Rotary Mud. J. M. Shimer. Petrol. Engr, August 1946, 17 (12), 131.—The serious effect which the compressibility of some muds has on the volumetric efficiency of mud pumps is illustrated by a few simple calculations. Various means of reducing this effect to a minimum are discussed. R. B. S.

342. New Rotary Tool is Used to Keep Drill-Pipe Free. K. M. Fagin. *Petrol. Engr*, October 1946, 18 (1), 272.—This new tool consists of a steel sleeve mounted slidably on a mandrel placed between the drill pipe and drill collars : the outside diameter of the sleeve is slightly larger than the outside diameter of the drill collars. The sleeve normally turns as drilling proceeds, but if it becomes stuck the entire drill stem can be lowered about 2 ft and rotated without turning the sleeve : it can then be removed by jarring or by pulling up and rotating. The drill collars are unlikely to stick owing to their smaller diameter.

The tool is described in detail and is illustrated by photographs and drawings.

R. B. S.

343. Sodium Chromate Used in Permain Basin Drilling to Combat Salt-Water Corrosion. G. Weber. Oil Gas J., 7.12.46, 45 (31), 103.—Sodium chromate concentration of about 1800-3000 p.p.m. is used to reduce corrosion fatigue, 50-100 lb of chemical to about 50 gal of water being introduced to the flow line at the rate of about 50 g.p.h. Once the correct chromate concentration in the mud has been reached, small daily additions will maintain proper proportions. Cost is 6 cents per foot drilled. Use of chromate not likely to extend at present owing to the shortage of supplies and increased demand. G. A. C.

344. Pressure Maintenance and Gasoline Absorption Plant in Santa Barbara Field, Venezuela. H. M. Russell and E. Moncrief. Oil Gas J., 28.12.46, 45 (34), 164.—Wet gas from the field separator stations at 50 lb pressure is processed in the plant and dry absorber gas returned to the producing formation at about 2300 lb pressure. The pressure-maintenance plant consists of one vacuum and six three-stage 6-cylinder compressors, with a daily capacity of 21,000,000 cu ft of gas.

Injection is into 13 wells, the 13,500,000 cu ft returned will soon be increased to 16,500,000 when three other wells are brought into the system.

A gasoline plant of 25,000,000 cu ft of gas capacity extracts propane, iso-butane, n-butane, iso-pentane and heavier. Motor gasoline, kerosine or absorption oil is manufactured on the two-column crude unit. A dehydration plant can treat 25,000,000 cu. ft of natural gas per day, using Al_2O_3 desiccant. When compressed to 2500 lb the dew-point does not exceed 50° F after treatment.

A crude treating plant of 6-8,000 brl per day of raw crude handles the cut oil produced in the field, a process of heating and chemical treating being employed. Water requirements necessitated a water station at artesian wells located ³/₄ mile from the plant site, the water being softened before use in the plant. Ancillary electrical and steam-generating plant have also been installed. G. A. C.

Production.

345. Acidizing Increases Water Intake Rates. R. J. Pfister. Oil Wkly, 11.11.46, 123 (11), 70.-It has been found that waters of low pH increase the intake rates of tight sands. However, low pH water and brines show a favourable effect only as long as these waters are entering the sand face; the rates decrease when fresh water is again injected, but acidization is directed to leave a permanent change in the well which will maintain a permanent increase as long as clear, sediment-free water is injected in the well. Acidization of production wells has become very successful in other areas, particularly in limestone formations, but more recently sandstones have also been successfully acidized with the development of special acids. In these wells, a treatment often involves the use of 3000 or more gallons of acid injected at several thousands of pounds pressure. While such practice is rather common, the equipment is elaborate and the service expensive in secondary recovery operations. It therefore seemed desirable to carry out some experiments with acidization in an attempt to devise an inexpensive treatment. In order to determine if these experiments are truly successful, it is necessary to follow the water input rates before and after acidization and to gauge water and oil production. The work to date is only a start but the results are encouraging. The desired method of preparing a well for acidization and the one ordinarily employed is described.

The treatment of 9 experimental wells and the results obtained are described. The intake rates generally increased. A. H. N.

346. Corrosion and Preventive Methods in the Katy Field. R. C. Buchan. Oil Wkly, 18.11.46, **123** (12), 25. (Paper presented before A.P.I. 12.11.46.)—The Katy gascondensate field and the producing and cycling equipment used in its production are described. The effects of acidic water corrosion are illustrated and discussed. The use of plastic-coated pipe and the use of soda-ash as a neutralizing agent are described as being practical means of reducing corrosion losses in the Katy field. The need for continued research and for field testing of alloys is pointed out. Instead of waiting for a complete understanding of such problems, it is advocated that full-scale field tests be initiated as soon as corrosion is found in new fields. The arrangement of subsurface equipment to facilitate corrosion control is discussed briefly. The importance of keeping equipment in safe working condition is emphasized. A. H. N.

347. Tests at Cycling Project Demonstrate Possibilities of New Corrosion Inhibitor. W: H. Justice and E. N. Jones. Oil Gas J., 9.11.46, 45 (27), 86. (Paper presented before Nat. Gasoline Assoc. of Amer. Corrosion Research Project Committee.)—In an attempt to inhibit corrosion in gas-condensate wells in Texas, a chemical called "Kontol 115" made by Tretolite Co. was tested. After extensive laboratory test, this material was found to have the following properties. It is a semipolar organic reagent which is chemically attracted to metal surfaces. The adherent, invisible protective film thus formed inhibits the attack of the metal by corrosive materials. This material is completely oil soluble and has no tendency to form precipitate with magnesium and calcium salts. Tests were performed on field scale and the results are presented and appear to confirm the efficacy of the material in inhibiting or retarding corrosion.

A. H. N.

348. Mechanics and Economics of Dual Completions. H. C. Laird. Petrol. Engr, August 1946, 17 (12), 165.—A brief outline is given of dual completions in California and the Mid-Continent. Some of the problems encountered and the methods of overcoming them are discussed: tools and other equipment used are described in detail and well illustrated by diagrams. The paper ends with a review of new equipment being developed. R. B. S.

349. Estimating Crude Oil Reserves. K. M. Fagin. *Petrol. Engr*, September 1946, **17** (13), 92.—The three usual methods of estimating reserves are (1) the production decline curve method, (2) the volumetric method, and (3) the analytical method. The

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first method cannot be used until the production has declined naturally for two or three years: the estimates by this method vary according to the economic limit which the producer fixes for the rate of production as the reservoir nears depletion. The volumetric method takes into account (1) the areal extent of the reservoir, (2) the sand thickness, (3) the porosity, (4) the commate water content, and (5) the shrinkage factor of the oil: the estimates by this method also vary with the recovery factors assumed for the various reservoirs. The analytical method only receives brief mention at the end of the paper. R. B. S.

350. Separators and Tanks. W. L. McCloy, Jr. Oil Gas J., 16.11.46, **45** (28), 281. (Paper presented before A.P.I. as part of A.P.I. Symposium on Secondary-Recovery Projects.)—Consideration is given to methods and equipment used in the delivery of oil from the well as "well fluid" through the various stages of separation to the stock tanks as "pipe-line oil". Various methods and equipment "hook-ups" for treating emulsions are set forth diagrammatically. A. H. N.

351. The Chemical Demulsification of Crude Oil. L. T. Monson. Petrol. Engr, September 1946, 17 (13), 69.—The use of chemicals in the demulsification and desalting of crude oil and their adaptability for the demulsification of other water-in-oil emulsions is briefly discussed.

352. Source and Purification of Gas Supply. L. L. McWilliams. *Oil Wkly*, 25.11.46, **123** (13), 38. (*Paper presented before A.P.I.* 12.11.46.)—The types and sources of gas for injection purposes are discussed. A list of undesirable gases is presented and the tests for these gases and methods for their elimination are indicated. Finally, a brief study of the economics of purification of injection gas is made. The chief components to be removed are hydrogen sulphide, carbon dioxide, oxygen, and water vapour. A. H. N.

353. Economics of Modern Oil Treating. R. R. MacDonald. Oil Wkly, 16.12.46, **124** (3), 14.—It is urged that oil producers should entrust the treatment of the oil, to obtain clean oil within the specifications for water content and gravity, to an expert whole-time oil treater whose responsibility should be to provide adequate treating equipment for any emergency. Examples are quoted where treating the oil efficiently has not only saved its own cost and kept the supply of oil up to the limit of the demand, but also produced good dividends. General remarks about the care to be taken in maintaining treating equipment are made. A. H. N.

354. Development Economics of Hawkins Oil Field. K. M. Fagin. Petrol. Engr, August 1946, 17 (12), 92.—A brief account is given of the development of the Hawkins oilfield in Wood County, Texas. Production is from the Woodbine sand : the geology and structural characteristics are described and details are given of reservoir pressures, oil shrinkage, and oil recovery factors. R. B. S.

355. Plastic Plugging Reduces Gas-Oil Ratios. E. S. Bauer. Oil Gas J., 31.8.46, 45 (17), 88.—The plugging material described is Resinox, a phenolic, low-temperature curing resin. To run in for a gas plug, a temperature survey must be first made by using a continuous-recording temperature bomb. Since the gas area is generally at a lower temperature than the oil level, a study of the temperature curve will indicate the approximate location of the gas-oil contact. The well is pumped full of oil to overcome and seal off the gas pressure. Depending upon the depth of the well and the amount of pressure experienced, between 6 and 8 hrs will be required for this operation. While oil pressure is maintained, the tubing is pulled from the well. In most cases it will not be necessary to maintain positive pressure since the pressure caused by the hydraulic level of the oil will usually be sufficient. Depending upon the type of equipment used, total set-up time and pulling time will require between 8 and 24 hrs. With new, high-speed equipment, this time is reduced materially, and it is possible to pull 5000 ft of tubing in about 21 hrs. A special drillable plastic bridge is run in on a wire line to a point slightly below the gas-oil contact and is sealed to the wall with plastic cement. This prevents the resin sealer, which will be added later, from going into the oil pay. The tubing is now re-inserted until it rests on the top of the bridge. Using a specially constructed pumping truck, the plastic is then pumped through the tubing into the well. The well is capped and between 200 and 800 p.s.i. pressure is applied. This forces the Resinox out through the porous structure from which the gas is intruding. The resin is allowed to cure for 6-8 hrs, after which the well is drilled and cleaned. A. H. N.

356. Use of Plugging Agents. H. T. Kennedy. *Oil Wkly*, 18.11.46, **123** (12), 61. (*Paper presented before A.P.I.* 12.11.46.)—Recent developments in the use of plugging agents in secondary-recovery operations are discussed. These include the use of various finely powdered solids—such as cement, colloidal clays, and wax distillate—which are added to the water at the input well in water flooding. The use of smokes of various compositions, as applied to gas- or air-repressuring projects, is also discussed. The plugging of water, which by-passes oil in fields which are not being artificially flooded or repressured, conserves propulsive energy, and allows commercial production of oil that could not otherwise be obtained. It may, therefore, be considered as a method of secondary recovery itself, comparable in importance with repressuring or water flooding. Recent developments in this field are discussed. A. H. N.

357. Pumping-Equipment Selection for Secondary-Recovery Developments. E. N. Kemler. Oil Gas J., 16.11.46, 45 (28), 287. (Paper presented before A.P.I. as part of A.P.I. Symposium on Secondary-Recovery Projects.)—Summary data are given on horse-power requirements available on small and shallow wells. Proper counterbalancing is a most important factor to be considered, both on central powers and beam wells. A. H. N.

358. Hard-Faced Valve Seats Extend Pump Life. E. Sterrett. Oil Wkly, 11.11.46, 123 (11), 54.—It is stated that whilst the money cost of servicing oilfield pumps and auxiliary equipment may be negligible, the monetary loss sustained through prolonged shut-downs due to failure of these equipment may be considerable. One of the operating divisions of The Pure Oil Co. has worked out a method for reconditioning worn valve-seat spiders and replacing the wearing surface with hard-facing material to take the pound of the valve. Through adoption of this revamping of pump design, the effective service life of the spider has been extended from the former three or fourmonth replacement schedule to an average working life of a like number of years—extending the interval between replacement shut-downs 12 times. Photographs supplemented by descriptions give the method of hard-facing the valve seats.

A. H. N.

359. Oil Production by Water. Part 2—Dry-Oil Recovery for Uniform Distribution of Pay. P. J. Jones. Oil Gas J., 9.11.46, 45 (27), 88.—The oil recoverable before edge water appears in production varies with a number of factors including the distribution of pay. This article is limited to uniform areas/foot of dip distance and to uniform pay thickness. For such structural and stratigraphic conditions, the acre-feet of pay invaded by water/foot of updip advancement is uniform. The in-place oil varies with a porosity, interstitial water, and volume factor. The recoverable oil depends on the fluid factor. The latter varies with the volume factor for oil and with the viscosity ratio of reservoir liquid to that of water. The oil displaced ahead of water in a given reservoir depends on the distance advanced by water before reaching producing wells. Two contours called B and M are used in estimating producing rates. The structural position of the B and M contours varies with time. A. H. N.

360. Importance of Research in Secondary Recovery Water Flooding. R. V. Hughes. *Petrol. Engr.*, August 1946, 17 (12), 180. (*Paper presented at annual meeting, North Texas Oil and Gas Association, Wichita Falls, Texas, March 1946.*)—A thorough understanding of the permeability distribution and structural conditions of reservoir sands, and the location of edgewaters and gas caps is of prime importance in all secondary recovery developments. A factor known as the specific injectivity index is suggested as being of more value to the secondary recovery operator than mere permeability values: specific injectivity index is defined as the input rate in barrels of water per day for each foot of sand per pound sand face pressure. The need for proper treatment of input waters is also stressed. Treatment of fresh waters should consist of removal of iron and manganese by aeration, addition of chlorine or copper sulphate for control of organic growths, addition of lime to raise the pH in an effort to help prevent corrosion, and filtration to remove all suspended matter that might clog the sands. It is also suggested that all input waters should possess the added property of keeping the clay and clay-like minerals of sands in a permanently flocculated condition. Salt waters and produced brines flocculate the clay-like minerals in a sand as will waters on the acidic side, but one big objection to the use of brines or acidic waters is increased corrosion. It has been found that corrosion can usually be reduced by thorough removal of the dissolved oxygen, but research is necessary to find or develop chemicals that could be added to treated, high pH waters, to give them the flocculation of clay properties.

Selective plugging practices for the reduction of by-passing are still in the experimental stage, but chemical plugging agents and plastics seem to offer the greatest possibilities in this direction. Finally, the present status of reservoir fluid flow research is reviewed. An excellent bibliography of twenty-one references is appended.

R. B. S.

361. Utilization of Old Wells. W. A. Heath. Oil Wkly, 18.11.46, 123 (12), 35. (Paper presented before A.P.I. 12.11.46.)—The prime advantage of using old wells is a large saving in development cost. Disadvantages consist of irregular spacing, poor mechanical condition of the well bore, exposed gas, or thief formations which may be difficult to isolate because of having been shot with nitroglycerin. Deposition of paraffin and other residues in the well bore is troublesome in certain areas—particularly in the eastern district; and, if not removed prior to conversion of an old well to an input well, it may greatly reduce the efficiency of the driving medium. Methods and suggestions for removing the paraffin are given. In the Mid-Continent district little difficulty is encountered in deposition of residues, and no special precaution other than a mechanical clean-out is performed in conversion of a well to input. In some instances precipitation of calcium, barium, or strontium salts on the sand face has occurred, and special treatment is required. Reasons for intensive secondary-recovery development as practised in certain areas are discussed. A. H. N.

362. Secondary Recovery in the Nowata-Claggett Area. A. Gibbon. Oil Wkly, 9.12.46, 124 (2), 48.—The history and development of the pool previously to secondary recovery is summarized. Characteristics of the sand and production data are presented. A factor "C" is developed which represents the barrels/acre-foot at well density of 5 acres/well multiplied by 1.6. The method of estimating the factor "C" and of using it is discussed in some detail. Economic studies of the field are briefly presented. A. H. N.

363. Distribution Systems and Surface Injection Equipment in Secondary Recovery. C. H. Keplinger. Oil Wkly, 2.12.46, 124 (1), 42. (Paper presented before A.P.I. 12.11.46.)—Consideration has been given to distribution systems and well-injection equipment for secondary recovery of oil by air, gas, and water. Economical distribution systems may be designed on a sound engineering basis if the important factors such as volumes, pressures, and expected life of proposed projects are accurately estimated. Standard surface well-injection equipment may be varied to meet local conditions. Individual well meter equipment should be provided for every project. A. H. N.

364. Distribution Systems and Surface Injection Equipment. C. H. Keplinger. Oil Gas J., 16.11.46, 45 (28), 300. (Paper presented before A.P.I. as part of A.P.I. Symposium on Secondary-Recovery Projects.)—Consideration is given to distribution systems and well-injection equipment for secondary recovery of oil by air, gas, and water. Economical distribution systems may be designed on a sound engineering basis if the important factors such as volumes, pressures, and expected life of proposed projects are accurately estimated. Standard surface wellinjection equipment may be varied to meet local conditions. Individual well-meter ecuipment should be provided for every project. A. H. N.

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365. Operators in Hull and Silk Field Study Repressuring Programme. C. H. Keplinger and J. M. Wanenmacher. Oil GasJ., 31.8.46, 45 (17), 76.—The history of the Hull and Silk field in Texas is reviewed, followed by a detailed description of the more important and significant horizons. Data on the gas-oil ratios obtained for the different sands are presented and oil reserves are estimated. It is estimated that in order to obtain the anticipated 5,300,000-brls increase in oil recovery, it will be necessary to inject approximately 22,000,000 M.c.f. of gas. It is believed that this gas be injected at a pressure of 750 p.s.i. The main expense of the injection programme will be the charges for compressing gas. Based upon a possible pressure service of 2 cents/M.c.f., the total cost of compressing the gas will amount to 440,000 dollars. Purchase of gas meters for injection wells and conversion of oil wells to gas injection wells should not amount to more than 250 dollars/well. The cost may be increased, however, if it is found necessary to depen proposed gas-injection wells so as to expose all of the pay section being produced by other wells in the vicinity. A. H. N.

366. 11,667 Productive Acres Repressured in West Pampa Co-operative Project. K. B. Barnes. Oil Gas J., 9.11.46, 45 (27), 66.—The field is composed of 101 leases. Preliminary studies were started in 1943; on March 25, 1946, the first eleven injection wells were put into operation. The organization of personnel and responsibilities is briefly explained. Similarly brief discussions are made of the gas-oil ratio tests, of reconditioning the oils and of level determination in input wells and other engineering data. The following table summarizes the data up to September 1946.

Gross oil production, b.d.				11,308
Average production/producing well, b.d.			- T	12.63
Gas production, M.c.f./day at 14.65 pressure base				17,701
Gas injected, M.c.f./day at 14.65 pressure base				4,338
Per cent of produced gas injected				24.5
Produced gas-oil ratio, cu. ft/brl			-	1,565
Injected gas-oil ratio, cu. ft/brl				384
Net gas-oil ratio, cu. ft/brl				1,181
Maximum injection pressure, p.s.i.				479
Minimum injection pressure, p.s.i.				93
Average injection pressure, p.s.i.				261
Producing days				30
Number of input wells in service				75
Number of producing wells				895
Total acreage in repressure area				11,667
Average oil recovery, brl/acre				6,062
Cumulative oil production as of September 30, 1946	, bi	d .		70,722,883
Cumulative gas injected since March 25, 1946, M.c.f				763,489
				A. E. N

367. Langlie Unitized Repressuring Project. R. L. Gray. *Oil Wkly*, 25.11.46, 123 (13), **32.** (*Paper presented before A.P.I.* 12.11.46.)—The results of 5 years of operation under a gas injection programme are summarized. The project known as the Langlie Unitized Repressuring Project is located in south-eastern New Mexico. The project was started when the average reservoir pressure was 615 p.s.i. (original pressure was estimated as 1400 p.s.i.). After 5 years of injecting gas into 2 wells, the average pressure had decline to 467 p.s.i. in the 13 wells. The average gas—oil ratio at start of injection was 2000 cu. ft/brl, and is now about 11,000 cu. ft/brl. The greatest operating problem, the channelling of gas, has been solved to a certain extent by controlling injection of gas by packers. It is estimated that recovery by gas injection ultimately will be 43.5% greater than primary operation for injection period, or 14.8% greater for entire life. A. H. N.

368. Practical Application of Geology to Reservoir Analysis. W. W. Wilson. *Petrol. Engr.*, September 1946, 17 (13), 152.—Details are given of the history, stratigraphy, and structural geology of part of the Kanesholm Pool in McKean County, Pennsylvania. The use of this type of study in reservoir analysis is explained. The most important application is in determining the mobility of fluids within the reservoir. If the in-

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dividual porous layers are areally extensive, and are of such physical character as to permit the free movement of fluids, reservoir forces may be determined from the observed fluid movements. However, the mode of deposition of a sand-producing formation can minimize the effect of the natural reservoir forces. In such cases, it may be impossible, without a detailed geological analysis, to determine the reason for the apparently anomalous reservoir behaviour. R. B. S.

369. Reservoir Performance and Well Spacing. Silica Arbuckle Pool, Kansas. L. F. Elkins. Oil Gas J., 16.11.46, 45 (28), 201. (Paper presented before A.P.I.)-The Silica Arbuckle pool of Kansas, producing from the Arbuckle dolomite by water drive, provides one case history for study of the recovery mechanism and for intrapool analysis of the recovery-well-spacing relation for this important type of petroleum reservoir. Pool performance to date indicates no substantial difference in ultimate recovery efficiency directly attributable to increased average well density within the range of 10-40 acres/well in this pool. Tests in this pool show interferences within a few hours between wells as much as 1860 ft apart. Disagreement between the theoretical pressure reductions in a homogeneous reservoir and those measured in the produced and shut-in wells suggests the presence of high permeability streaks comprising a relatively small fraction of the total pore space. It is hypothesized that the recovery mechanism for this type reservoir is primarily that encroaching water gradually displaces oil from the less permeable channels through which oil flows into the wells. With this mechanism, the number of wells penetrating the same system of extremely permeable streaks should not greatly influence recovery from that part of the reservoir in communication with these streaks. This is in agreement with the recovery-wellspacing relation indicated by the over-all performance of the Silica Arbuckle pool.

A. H. N.

370. Gas-Condensate Reservoirs. O. F. Thornton. *Oil Wkly*, 18.11.46, **123** (12), 42. (*Paper presented before A.P.I.* 12.11.46.)—Ten years of operation of gas-condensate reservoirs has verified the necessity for and practicability of co-operative and unitized operation. Three types of gas condensates are now recognized : wet-gas, retrogradegas, and reservoir-liquid. The operating method for each reservoir should be based upon the characteristics of the gas condensate at reservoir conditions. Other factors such as richness of the gas, size of the reserve, capacities of wells, nature of the reservoir, and mode of occurrence of the gas condensate must be considered. Marketing conditions, tax position, and other factors are also important. Due to the increasing volume of the gas market, and prospects for chemical conversion of gas to liquid fuel by the Fischer-Tropsch process, many operators will be required to make a choice or compromise between complete pressure maintenance and gas sales. This can be done intelligently with known methods of evaluation.

371. Suspended Matter in Flood Water. Anon. Oil Wkly, 14.10.46, 123 (7), 61.— Suspended matter in flood water is present due to (1) being in the untreated raw water supply; (2) resulting from aeration; and (3) resulting from corrosion of pipelines in the distribution system. Suspended matter in the raw, untreated water supply being used for flooding operations is organic matter, sand, silt, other foreign matter, etc., and is usually referred to in water analysis as turpidity and colour. Suspended matter may be broken down into two classifications, as "sediment" which will rapidly settle out, and "turpidity" which slowly settles out. However, nearly all forms of suspended matter are usually referred to as turpidity. Colour of the water also is related to suspended matter in that it is almost invariably due to organic matter usually extracted from decaying vegetation. Methods of removal by aeration and coagulation are briefly described. A. H. N.

372. Oil Production by Water. Part 3—Oil Ahead of Water. P. J. Jones. Oil Gas J., 16.11.46, 45 (28), 314.—Reservoirs have three dimensions and displacement of oil by water is in three dimensions. For production purposes, it is convenient to replace the structural and stratigraphic characteristics of reservoirs by a factor called convergence of reserve. Convergence is a number which combines structure and pay thickness. The limiting values are zero and two. In the vicinity of an injection well, convergence is equal to zero. For a uniform distribution of pay, convergence is equal to unity.

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Along the crest of a reservoir, convergence is equal to two. The oil displaced ahead of water, aside from expansion, varies with the fluid factor, convergence and the distance advanced by water before reaching producing wells. A. H. N.

373. North Texas Water-Flooding Possibilities. A. Gibbon. Oil Wkly, 28.10.46, 123 (9), 47.—A summary of the findings of the U.S. Bureau of Mines in studying the water-flooding practices of North Texas is presented and discussed. The history of various fields and projects is briefly indicated. One company operating two adjacent projects used two types of well spacings: a five-spot and a nine-spot pattern. In the five-spot pattern project with like wells spaced at 300-ft intervals, the response to water injection was relatively rapid and the peak of oil production was attained after approximately 14 months. In the case of the nine-spot pattern the oil-producing wells were drilled at 300-ft intervals with the centre well of each group of nine serving as a water-injection well. Response to water injection was much slower than on the five-spot pattern project, and peak oil production was not attained until after $2\frac{1}{2}$ years from the inception of water injection.

The open-type systems and the methods of water-treatment are described. Production data are presented graphically. A. H. N.

374. Flowing Water-Flood Production. T. F. Lawry. *Oil Wkly*, 18.11.46, **123** (12), **54.** (*Paper presented before A.P.I.* 12.11.46.)—Flowing of water-flood production was attempted very early in the Bradford field, Pa, but did not become popular until the development of water flooding in the shallow Mid-Continent fields. The advantages of flowing over pumping lie in the simplicity of operation, and economy of first cost, as well as of operation. Flowing is used mainly in the shallow water-flood operations in the Mid-Continent sands, in which permeability and viscosity do not seriously retard the injection of sufficient water volume. The experience with flowing to date has been such that there seems to be no difference in the ultimate recovery of water flooding— A. H. N.

375. Salt-Water Disposal. W. S. Morris. *Oil Gas J.*, 31.8.46, **45** (17), 92.—In this, the concluding article of a series dealing with East Texas water disposal projects, data on the production of oil and water and the quantities injected are presented and discussed. A. H. N.

376. Construction and Calibration of Sun Permeameter. A. B. Long. *Oil Wkly*, 28.10.46, **123** (9), 44.—The construction, calibration, and use of an instrument to measure the permeability of rock samples to air are described. Flow is maintained under constant pressure differential and the manometer of an orifice on the outlet is calibrated directly in millidarcys. A. H. N.

377. Salt Quickly Cleans Flow Lines. L. N. Scheuermann. Oil Wkly, 11.11.46, 123 (11), 57.-It is found that salt of the variety known as "ice-cream salt" is useful in clearing paraffin deposits from oil lines. Insoluble in oil and readily soluble in water, salt is introduced as a mechanical abradant in entrainment with the oil in the line where it acquires sufficient momentum to cut the paraffin in a mechanical manner. The minimum flow pressure is about 130 p.s.i. If the pressure is less, it can be built up by taking pressure from another well or by using a pump. One advantage of using salt is that if any accumulation results from combinations of the paraffin and abrasive, the abrasive can be dissolved out by circulating water through the flow lines to release the pack-up. However, in over 2000 tests, no pack-up has occurred. Salt has the following properties which are necessary to remove hydrocarbon deposits: (1) Crystalline form and not too fine; (2) Sufficient hardness; (3) Insolubility in petroleum oil; (4) Solubility in water; (5) Non-poisonous; (6) The general properties of not reacting with oil or water; (7) Non-injurious to equipment or personnel. Equipment for injection of the salt is described. In general, a by-pass is installed and the line-oil is used to inject the salt from a pipe or a hopper into the main-line. A. H. N.

378. Laboratory for Production Problems. R. Sneddon. Petrol. Engr, September 1946, 17 (13), 178.—A brief description is given of the Shell Oil Company's recently

completed production laboratory in Los Angeles. The contemplated programme of research is also outlined. R. B. S.

379. Engineering Developments in Southwest Texas. J. W. Crutchfield and H. T. Pruett. Petrol. Engr, October 1946, 18 (1), 208.—The most important engineering developments in this region have been connected with well completions and with problems connected with reservoir engineering. These developments are briefly discussed. R. B. S.

Oilfield Development.

380. Argentine Petroleum Industry (1). A. Landoni and A. Zanetta. Petroleum, 1946, 9 (11). (From the "Historia del desarrollo de' la industria petrolera en el país" published in "La Ingenieria," 1945, 49, 646–662.)—A historical review of the origin and development of the Argentine petroleum industry, including statistics of crude oil production and drilling. K. C. G. K.

381. Argentine Petroleum Industry (2). A. Landoni and A. Zanetta. Petroleum, 1946, 9 (12); 288.—The second part of an article dealing with exploring and drilling for oil in Argentina. K. C. G. K.

382. Search for Petroleum in Bahia (Brazil). A. I. de Oliveira. Bol. del Inst. Sudamericano del Petroleo, 1946, 2, 449-470.—Details of exploratory drilling in the State of Bahia, with maps and geological formations. The estimated reserves in the four fields covered are 7 million brl, with more than 1 billion cu. m. of gas. A. C.

TRANSPORT AND STORAGE.

383. Tank Ships. B. Saurino. Oil Gas J., 28.12.46, **45** (34), 160.—A review is given of the world tanker position to-day.

World fleet capacity increased 66% during the war. The U.S. owns 62.3% of the world tonnage to day compared with 23.9% owned on September 1, 1939, whilst Great Britain owns 16.2% which is within 5% of her pre-war figure. Total world tonnage amounts to $21\frac{1}{2}$ million deadweight tons, as compared with 13 millions at outbreak of war. The U.S. owns $13\frac{1}{2}$ million tons of present total.

The 1947 building programme shows 118 vessels under construction, mostly in Great Britain (52), Denmark (11), and Sweden (32). Only 2 are being built in the U.S.

Tables show world tank-ship fleets by flag as at January 1947, ships under construction or on order, the U.S. privately-owned tanker fleet as at January 1947, and average tanker charter rates for clean and dirty tonnage from U.S. to North Atlantic ports annually from 1928 to 1946. It is concluded that operating costs in the foreseeable future will remain at higher than previous levels, and that privately-owned tankers under U.S. flag can meet current domestic transportation if the big-inch lines are utilized for shipping liquid products from the Gulf Coast. G. A. C.

384. A Case Study in the Transportation of Natural Gas. J. E. Flanders. *Pipe Line News*, September 1946, **18** (9), 5.—A hypothetical example is discussed in detail to illustrate the marked effect which load factor has on the cost of transporting natural gases. The operating expenses taken into account in the discussion are those of : (1) compressor station operation, (2) compressor station maintenance, (3) measuring station operation and maintenance, (4) communication system operation and maintenance, (5) fuel, (6) gas losses, (7) sales, and (8) general overheads. R. B. S.

REFINERY OPERATIONS.

Refineries and Auxiliary Refinery Plant.

385. Air Compressor Operation. D. Attaway. *Refiner*, 1946, 25, 282.—Safe practices in air compressor operation are discussed shortly under explosion hazards, location and foundation, capacities, compressor lubrication, decomposition of oil, carbon

working pressures, air-starting piping, and personal protective devices. G. R. N.

386. Fundamental Factors in Corrosion Control. H. H. Uhlig. Chem. Eng. News, 1946, 24. 3154.—The author has surveyed the various methods of corrosion control and discussed the principles underlying them. Items dealt with are cathodic protection, metallic and organic coatings, inhibitors and passivators, corrosion-product coatings, effect of alteration of environment, influence of impurities in metals on their rate of corrosion, improvement of chemical resistance by alloying (stainless steels), and finally methods of achieving high temperature resistance for both the lower and upper zones of the high temperature range. The article is well illustrated with diagrams.

L. B.

387. Plate Efficiency of Fractionating Columns and Absorbers. H. E. O'Connell. Trans. Amer. Inst. Chem. Engrs, 1946, 42, 741.—A correlation of plate efficiency as a function of feed viscosity and the relative volatility of key components has been developed for fractionating towers from tests data on 29 commercial columns and 5 laboratory columns previously reported in the literature and from new test data on 3 commercial columns not previously reported. Also, the correlation of Walter and Sherwood for laboratory plate absorbers, which expresses plate efficiency as a function of viscosity and Henry's law constant, has been simplified and compared with the efficiency for commercial absorbers. The correlations are suitable for determining the plate efficiency in the design of commercial fractionating columns and absorbers.— (Author's abstract.)

388. Furnace Tube Decoking with Steam and Air. H. Bottomley. *Refiner*, 1946, 25, 377.—A short account of the removal of coke from furnace tubes by means of air and steam injection through the hot tubes with reference to the mechanics of the operation and the furnace temperature. The economics of this method are partially enumerated as (1) Reduced downtime when furnace cleaning is the delaying factor; (2) Reduction in man hours for tube cleaning; (3) Elimination of tool maintenance and repar; (4) Increased tube life; (5) Increased ease of tube and header inspection; (6) Elimination of tube turbining mess and noise. G. R. N.

389. The Effect of Heat Loss on the Performance of Exchangers with Interconnected Walls. P. R. Trumpler. Trans. Amer. Soc. Mech. Engrs, 1946, 68, 487.—Equations are devised for the calculation of exchangers in which the passage walls are bonded to each other, providing substantially uniform wall temperature over any cross section normal to the flow. Results are presented for both countercurrent and cocurrent exchangers and an example illustrating the solution is given.—(Author's abstract.)

390. The Influence of Viscosity on Centrifugal Pump Performance. A. T. Ippen. *Trans. Amer. Soc. Mech. Engrs.*, 1946, **68**, 823.—In order that the performance characteristics of centrifugal pumps for use in the oil industry could be predicted with a reasonable degree of certainty, an experimental study of the behaviour of various designs of pump was undertaken. The fluids used were water and oils with viscosities up to 10,000 s.s.u. Experimental results are given and the influence of points in pump design on performance with fluids of various viscosities is analysed and discussed. A. R. J.

391. Pilot Plant and Commercial Desalting. M. J. See, J. P. Lindahl, H. R. Taliaferro, and C. R. Harte, Jr. *Refiner*, 1946, 25, 463.—Desalting measures were necessary when S.O.C. Indiana at Whiting commenced refining West Texas crude containing up to 300 lb salt/1000 brl. Four desalting units of the coalescer and settling type are in operation. The process consists essentially of mixing a small amount of water with the crude, heating the mixture to about 230° F, coalescing by means of an excelsior bed and settling at a pressure sufficient to prevent vaporization. A demulsifying chemical is employed. The treated crude has an average salt content of about 30 lb./ 1000 brl. Pilot plant work has indicated with excelsior as the coalescent that with increased water addition it may be possible to obtain satisfactory desalting without a

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demulsifier : since the cost of this chemical is an important item attractive savings may be possible. Pilot plant runs on the use of glass fibres as the coalescent have given crudes of salt content around 10 lb/1000 brl with a satisfactory life of the medium. A full-scale programme is under way to compare the two coalescing mediums.

G. R. N.

392. Process Pumps for Oil Refineries and Similar Plant. W. F. Riester. *Petrol. Times*, 26.10.46, **50**, 1110.—An account is given of the requirements of pumps for oil refinery service and the importance of suction performance is stressed. Recent developments which have been responsible for the design of pumps giving better performance in oil refinery plant are described. R. B. S.

393. Thermal Conductivity. The Refiner's Notebook No. 124. W. L. Nelson. Oil Gas J., 21.12.46, 45 (33), 87.—A table and a graph are given from which the thermal conductivity of the various materials, used in refineries, may be obtained for use when determining the following: (1) the heat losses in furnace walls, pipe insulating materials, etc., (2) the heat transfer coefficients of liquids or gases, and (3) the thermal resistance of dirt or coke layers on exchanger and pipe-still tubes. W. H. C.

394. Losses through Heated Walls. The Refiner's Notebook No. 125. W. L. Nelson. *Oil Gas J.*, 4.1.47, **45** (35), 77.—An equation is given for computing the loss of heat by conduction through flat walls or surfaces. The factors that affect the film coefficient are described, viz. the temperature of the surface in contact with the air, the air velocity and the position of the surface (vertical, horizontal upper or lower, or sloping) and factors for them are given. The most troublesome factor is the temperature difference between the wall and the air, but the difficulty of this trial-and-error computation can be eased by the use of the chart presented. The composition of the chart is described and an example of its use is shown. W. H. C.

395. Electric Power in Oil Refining. W. H. Stueve. Oil Gas J., 21.12.46, **45** (33), 73. (Paper presented before the Petroleum Electric Power Assoc., Tulsa.)—Data relative to electric power, both purchased and refinery generated, used at U.S. refineries for the year 1929, 1939, and 1944 are shown and discussed and compared with the consumption of electricity in all U.S. manufacturing industries, and a survey of the electric and mechanics power used at 44 U.S. refineries in 1937 is given. It is shown that (a) in 1939 the use of electricity increased over 10 years from 1.78 to 3.18 Kw-hr/brl; (b) in 1937 the ratio of purchased to generated electricity was 1.58:0.64 Kw-hr/brl, and (c) to-day, refineries are 54% electrified. The trends are towards (1) the use of all electric motors for new applications and also a change from obsolete steam-driven equipment to motors, and (2) a larger use of purchased electricity, despite the fact, as shown later, that refinery generation is far cheaper. The reason appears to be that less L-P steam is required for process work than would be produced if all the electricity requirements were refinery generated by the use of H-P steam. Refinery generation, both of steam and electricity, is discussed from several aspects, and costs, capital expenditure, and amortization are given and compared with cost of purchased power. W. H. C.

396. Reclamation of Waste. J. L. Heath and P. Giblin. *Refiner*, 1946, **25**, 443.— Major sources of waste treated at Magnolia's Beaumont refinery are classified as (1) Oil rejected from treating units or refinery spillage; (2) B.S. and W. from crude oil tanks; (3) Oil displaced from pipelines to avoid contamination caused by pumping different products; (4) Refuse from tank cleaning operations; and (5) Oil present in waste troating reagents. These materials are gathered in an integrated system of sewers and settling tanks or ponds. To remove the maximum quantity of water before final demulsification some materials are handled differently from others. Materials classified in the first and third groups are transferred to the inter-refinerys eparators where some water is removed by settling. Materials in group 2 are pumped directly into the emulsion-breaking tanks. Groups 4 and 5 which contain large vols. of water are first transferred to the waste oil settling ponds. Final reclamation is carried out in emulsionbreaking tanks on a 48-hr operating cycle where the emulsion is heated to $120-150^{\circ}$ F sludge are withdrawn from the bottom and clean oil from the top, leaving an emulsion in the tank to go forward to the succeeding cycle. G. R. N.

Distillation.

397. Deposits Formed in the Refining Process. L. F. Shimansky. *Riv. ital. Petrol.*, November 1946, 163, 13.—The problem of the gummy deposits formed in the heating of the crude in refining is reviewed. It is linked up with the dissolved oxygen content of the crude, and examples are given of how the amount of deposit is diminished by various methods of cutting down this oxygen content. D. H. McL.

398. Operating Characteristics of Hypercal Fractionating Columns. P. L. Brandt, R. B. Perkins, and L. K. Halverson. *Oil Gas J.*, 7.12.46, **45** (31), 86.—The operation and performance of commercially available Hypercal Laboratory Fractionating Columns having a 25 mm by 36 in Heligrid packing is described.

Two types of columns were studied, the only difference being in the reflux control head. The Podbulniak-designed head is built directly within the vacuum jacket that insulates the column; the Shell-designed liquid-dividing head is a tipping bucket type, permitting the use of thermometers for vapour-temperature measurements. Still pots used are standard round-bottom flasks, heated with Glas-Col mantles. Boil-up rate control normally is manual.

The test liquid was a mixture of n-heptane and methylcyclohexane.

A series of tests show that the 25 mm diameter by 36 in long section of Heligrid packing is equal to the best of the small column packing. The equivalent of 90 theoretical plates and a hold-up of 0.36 ml per theoretical plate are obtainable at 500 ml per hr boil-up rates. Fractionating efficiency falls off with increasing boil-up rate; the theoretical plate value is 48 and hold up 1.07 ml per plate at 2000 ml per hr. An average of 8 hr is required at total reflux to attain equilibrium.

Distillation data at 100: 1 reflux ratio are presented for comparison with operation of other columns. G. A. C.

Absorption and Adsorption.

399. Absorber **Operating Efficiency.** E. G. Ragatz and J. A. Richardson. *Refiner*, 1946, **25**, 582.—The Kremser-Brown theoretical absorption tray analysis shows weakness in that its basic tray efficiency factor shifts markedly in value with percentage of key component recovered. The degree of this shifting varies widely for different columns and for different conditions of operation of a given column. Since it is rarely possible to operate a commercial column under an exact pre-set condition of feed quality, column loading, and key-component recovery this shifting of the tray efficiency drastically limits the usefulness of the conventional analysis for accurate specification definition or for precise column operation comparison. Recently, an analysis has been made of the operating characteristics of 40 commercial columns ranging in pressure from 30 to 1800 lb gauge From this a technique has been developed to evaluate absorber performance which utilizes an experimentally derived absorption factor chart which gives promise of fully correcting the limitations of the conventional Kremser-Brown method. G. R. N.

Cracking.

400. Automatic Control of a Fluid Catalytic Cracking Unit. M. MacDonald. *Refiner*, 1946, 25, 471.—A simplified account with diagrams of the various controls necessary to operate the unit. 88 controllers and 54 recorders are required. G. R. N.

401. Fluid Catalyst Technique. L. S. Daniels. *Refiner*, 1946, 25, 435.—A comprehensive account of the mechanical operations involved in the catalyst section of the fluid catalytic cracking process. Heat balances, auxiliary catalyst equipment, and calculations on fluid catalyst circulation systems are given. G. R. N.

402. Hydrogen Sulphide Removal from Cracked Gas. Anon. Refiner, 1946, 25, 505.—Dubbs gas at Fletcher Oil Co., Wilmington, California, contains 2500 grains H_2S per 100 cu. ft. This is reduced to 15 grains per 100 cu. ft by washing the gas in an

absorber type column with diethanolamine. The spent reagent is regenerated and disposal of H_2S is by burning. G. R. N.

403. Improved Houdry Reactor Design. R. C. Lassiat and C. H. Thayer. *Refiner*, 1946, 25, 453.—A major improvement in the Houdry catalytic cracking process, resulting in both lower operating costs and increased gasoline production, has been effected by re-designing the reactor tubes and changing the physical composition of the catalytic mass. The effect of these changes is discussed. G. R. N.

404. Commercial T.C.C. Operations. H. D. Noll, A. W. Hoge, and D. M. Luntz. Refiner, 1946, 25, 599.—The T.C.C. unit at Paulsboro (Socony Vacuum) has operated satisfactorily since March 1946 with concurrent flow of catalyst and oil through the reactor charging both vaporized and partially vaporized stocks. During this period the vapour-catalyst disengager (necessary for concurrent flow) functioned efficiently, steam purging of the spent catalyst was accomplished more easily than on countercurrent flow, and distribution of the liquid and vapour charge through the reactor bed was uniform. There was better utilization of the heat content of the inlet catalyst and oil streams giving higher average reactor temperatures which resulted in higher octane no. gasolines. Carry over of catalyst fines to the synthetic crude was negligible, while there was no abnormal break-up of catalyst. Cost of conversion of a unit from counter to concurrent flow is about 1% of the initial investment. G. R. N.

405. Earnings—A Function of Catalyst Activity. R. E. Bland and E. A. Smith. Refiner, 1946, 25, 383.—Catalyst loss is the quantity of catalyst mechanically lost from a system. Catalyst make up is the sum total of catalyst added to a system to make up mechanical losses plus catalyst added to the system (balanced by physical catalyst withdrawal from the system) to maintain optimum catalyst activity. For example, T.C.C. units will operate on clay catalyst with a mechanical loss of 0.1 lb/brl. It is shown, however, that to maintain optimum catalyst activity from the economic standpoint equilibrium catalyst should be withdrawn from the system and replaced with additional fresh make-up. In the case of a 10,000 brl/day T.C.C. unit the total optimum catalyst replacement is indicated to be 0.8 lb/brl for maximum profit.

G. R. N.

406. Largest Unit of Kind in World. R. Maass and R. A. Lauterbach. Oil Gas J., 4.1.47, 45 (35), 45.—The delayed coking-plant of the General Petroleum Corp., at Torrance is fully described and shown by seven illustration and a flow diagram. The cracking portion of the unit is divided into two sections, each with its own furnace and a pair of coke drums to be used alternately. For the delayed coking operation the furnaces are designed for a high rate of heat transfer, and contain four separate coils in the radiant section, the charge first entering the hottest part of the convection section. The outlets from the radiant section flow by a common transfer line to the fractionator. The cooler portion of the convection section contains water-coils for providing process steam. Decoking is done every 24 hr and involves the use of a rotary boring-tool having water-jets, of different sizes for the operations of boring, reaming, and cutting out of the coke in the 80×17 ft drums. This tool is illustrated and its working, and the blowing-down operation of the full drum before boring, etc., are fully described. The operating conditions are : Reduced crude charge, 15,000 brl/day Furnace charge; 20,000 brl/day, Recycle: fresh feed ratio 0.33. The temperatures used are: Furnace outlet, 920° F; Drum inlet and outlet, 900 and 830° F, respectively, at 56 p.s.i. The yields from 700 sec, Saybolt Furol viscosity at 122° C reduced crude are : Total gas, 14 0% (wt), Raw B.B. liq vol 0.8%, Debutanized gasoline, 22.5% (vol), Light gas oil, 36.5%, Medium gas oil, 16.7%, Coke, 19.1% (wt). W. H. C.

Chemical and Physical Refining.

407. Recovery of Volatile Solvents in Industry. G. Tartarani. *Chim. e Industria*, 1946, 28, 7-8, 117.—The fundamental characteristics of the adsorption of gases and vapours by activated carbon and the other solid adsorbents most used in industry are summarized. The optimum conditions for obtaining the maximum efficiency for a given

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adsorbent are examined. Finally, an investigation is made of the more important industrial processes used in Europe for solvent recovery, together with a parallel summary of modern requirements which have become apparent in recent years as a result of great industrial development. D. H. McL.

Special Processes.

408. Air Oxidation of High Molecular Weight Petroleum Hydrocarbons. H. W. Zabel. *Chem. Ind.*, November 1946, **59**, 821.—Contrary to the general opinion that this process has been operated for any length of time in Germany alone, it has been used in America since 1926 though there, apart from the production of certain aldehyde fractions, for denaturing ethyl alcohol, it did not progress to commercial scale until the demand for lubricating oil dopes provided a major continuous market.

The type of feed-stock for the process (highly paraffinic hydrocarbons with boiling points ranging from gasoline to petroleum waxes) is determined by the nature of the product required, and the oxidation is carried out at $200-350^{\circ}$ F. To initiate the reaction the presence of heavy metal soaps, or high molecular weight ketones or alcohols, is required. The off-gas contains water, carbon dioxide, and nitrogen, with formic, acetic, and other low boiling fatty acids.

After the oxidation is completed, the product is neutralized with caustic soda and the mixture of alcohols and ketones can be drawn off from the surface of the oil for use as an anti-corrosion agent or for subsequent sulphation and sulphonation to give surface-active agents. The water-insoluble fatty acids are isolated from the soap solution, or they can be esterified to give lubricating oil additives or, since they have a low vapour pressure, they may be useful as plasticisers. The amine salts of these acids are effective defoaming flotation agents.

The alkaline-earth soaps are used in preservative oils and are prepared in the oil medium from the sodium soaps by treatment with aqueous solutions of alkaline-earth salts. They are stored in solution in oil after filtration to remove oil insolubles. Heavy metal soaps can be prepared similarly for use as cloth impregnants and gelling agents for fuels and lubricants. Large quantities of the hot oxidized hydrocarbon products are used in the manufacture of dispersed metal soaps for control of corrosion. O. M.

409. Fischer-Tropsch Process : Present and Future. C. C. Hall. Engineering, 10.1.47, 163, 30.—Considering German progress with this process, it is suggested that it would be uneconomic to operate in Britain without first effecting either a reduction in the cost of the synthesis gas or an improvement in the efficiency of the process. A short historical survey is given in which it is pointed out that during the war the process yielded only 8% of Germany's home oil production compared with 45% produced by high-pressure hydrogenation of coal and tar. At present the greatest use of the process is producing raw material for the chemical industry. The article, which is to be continued, describes the process and compares the relative efficiencies of brown coal and coke for production of the synthesis gas. G. P. K.

410. Hydroforming for Production of High-Octane Motor Fuel. L. R. Hill, G. A. Vincent, and E. F. Everett. *Trans. Amer. Inst. Chem. Engrs*, 1946, **42**, 611.—Published data on hydroforming to produce automotive gasoline are meagre because half the plant capacity was built since 1941, and all of the plants were used during the war for the production of toluene and aviation-gasoline blending components.

The hydroforming process converts low-octane naphthas into stable, high-octane motor gasoline by means of dehydrogenation and cyclization. These reactions are promoted by a molybdena-on-alumina catalyst at temperatures of $900-1000^{\circ}$ F and pressures of 150-300 p.s.i. gauge, with a high partial pressure of hydrogen in the reaction zone. Hydrogen is one of the products of the reaction, which makes it possible to maintain a high hydrogen concentration in a gas stream which is recycled to the reactor along with vaporized feed.

Hydroforming is carried out in a unit having four reactors filled with catalyst, two of which are always in series on reaction and two in different stages of regeneration. The reactors are switched from reaction through several regeneration steps and back to reaction in cycles of 8–16 hr duration by an electric cycle-controller. Regeneration is 100 a

necessary because a small deposit of carbon and a partial reduction of the metal in the catalyst combine over a period of hours to reduce the activity of the catalyst. When charging naphthas of high sulphur content, a gradual sulphiding of the catalyst also contributes to the loss of activity. The carbon is burned and the catalyst re-oxidized by combustion in a stream of air greatly diluted by cooled and recirculated flue gas.

The reaction products are recovered and fractionated in a 4-tower fractionating system which has as its products : (1) a hydrogen-containing gas substantially free of hydrocarbons heavier than propane, (2) a highly aromatic "polymer" boiling above 400° F, and (3) a depropanized, 400° F E.P. gasoline.

Hydroformer gasolines are characterized by a very low olefin content; a similarly low content of sulphur compounds, even when a sulphur-bearing naphtha is charged; low Reid vapour pressures; high clear O.N.; high lead susceptibilities.

Yields of 78-80 vol % of 80 CFR-M octane, 100% C_4 recovery gasoline are obtained, with the balance of the material going approximately three-fourths to C_4 -free gas and one-fourth to polymer and carbon. When operating to lower octane levels it is possible, by blending in extraneous butanes to raise the vapour pressure of the finished gasoline, to obtain a yield, based on feed, of 100% of 68-8 octane gasoline which can be brought up to 80 CFR-M octane by the addition of 1.5 c.c. of TEL.—(Author's abstract.)

411. The Isomate Process. J. E. Swearingen, R. D. Geckler, and C. W. Nysewander. *Trans. Amer. Inst. chem. Engrs*, 1946, **42**, 573.—The Isomate process is a method of converting low O.N. pentanes and hexanes into isomers of higher O.N. and volatility. A liquid aluminium chloride-hydrocarbon complex promoted with anhydrous HCl is used as a catalyst, and hydrogen is added to repress cracking and maintain high catalyst activity. Conversion is accomplished by passing liquid hydrocarbon charge in a dispersed phase through the catalyst complex. Preferred reaction conditions are 240–250° F and 700–800 p.s.i.

In a one-pass operation Isomate of about 80 CFR-M unleaded O.N. can be produced; and by separation and recycling of low O.N. pentanes and hexanes, a product of about 91 unleaded O.N. can be produced. Liquid yields are essentially 100%. Plants of 5000 brl per stream day and 1750 brl per stream day capacity have been constructed and successfully operated at Whiting, Ind., and Salt Lake City, Utah.—(Author's abstract.)

412. The Shell Vapour-Phase Isomerization Process for the Production of Isobutane. H. A. Cheney and C. L. Raymond. *Trans. Amer. Inst. chem. Engrs.* 1946, 42, 595.— This paper describes a process for the catalytic conversion of normal butane to *iso*butane. The isomerization catalyst consists of anhydrous aluminium chloride adsorbed on a granular alumina support. Anhydrous hydrogen chloride is used as the catalyst promoter. The reaction is carried out in the vapour phase at from 200° to 300° F, and under a pressure of from 150 to 260 p.s.i. gauge at average conversion levels of 40-45%.

A flow scheme is given, operation of the process is explained, and the manufacture of the catalyst from a natural alumina and aluminium chloride is described. The effects of the chief reaction variables and of various impurities which might be found in the normal butane feed are discussed. Average operating data are given for three plants covering a six-months' period.—(Author's abstract.)

413. Isomerization of Light Hydrocarbons. Stephen F. Perry. Trans. Amer. Inst. chem. Engrs, 1946, **42**, 639.—This paper describes processes for the conversion of normal butane to *iso*butane and of normal pentane to *iso*pentane, which were developed cooperatively by the Anglo-Iranian Oil Co. and the Standard Oil Development Co. The essential features of both processes include : (1) the use of a highly selective solid catalyst, namely, $AlCl_3$ adsorbed on bauxite, and (2) a technique for maintaining the activity of the catalyst by the introduction of fresh $AlCl_3$ along with the feed.

Butane isomerization plants utilizing the process described in this paper have been built in sizes ranging from 600 to 3600 brl of *iso*butane per day, the combined capacity amounting to about 25,000 brl per day. A typical plant is described in detail. Several of the plants were constructed almost entirely from existing equipment, with a substantial saving in time and critical materials, when the wartime need for *iso*butane was most pressing. Plant performance data and the major operating difficulties encountered and overcome are discussed.—(Author's abstract.)

Metering and Control.

414. Instrument-Air-Supply Systems. W. C. Ludi. *Refiner*, 1946, 25, 478.—An outline is given of present practice in the design of instrument-air-supply systems for process units. These systems are important in plants using automatic control instruments since continuous satisfactory performance is essential to the production of specification products and the maintenance of operator morale. For design purposes basic engineering data are given on pressure requirements and instrument-air consumption. Also included is a discussion of instrument-air drying methods and systems and notes on the principal design features desired in the mechanical equipment.

G. R. N.

415. Pulsation and Its Effect on Flowmeters. E. J. Lindahl. Trans. Amer. Soc. Mech. Engrs, 1946, 68, 883.—Errors in flowmeter readings can be caused by pulsations in the fluid which is being measured. This type of error is dealt with and methods for reducing its severity are given. A. R. J.

416. Dynamic Behaviour and Design of Servo Mechanisms. G. S. Brown and A. C. Hall. Trans. Amer. Soc. Mech. Engrs, 1946, 68, 503.—A mathematical treatment is given of the factors influencing the design and the satisfactory working of servo-mechanisms when used for various purposes. A. R. J.

Patents.

417. Patents on Refining Processes and Products. R. E. Burk, assr to S.O.C. Ohio. U.S.P. 2,400,874, 28.5.46. E. C. Hughes and J. D. Bartleson, assrs to S.O.C. Ohio. U.S.P. 2,400,875, 28.5.46. Recovery of boron trifluoride catalyst from admixture with hydrocarbons by absorption in dimethylaniline or diphenylamine under suitable conditions.

W. O. Keeling and W. L. Glowacki, assrs to Koppers Co. Inc. U.S.P. 2,400,883, 28.5.46. Purification of benzol by crystallization and centrifugation.

B. L. Evering and E. L. d'Ouville, assrs to S.O.C. Indiana. U.S.P. 2,400,922, 28.5.46. Aviation gasoline components are obtained from light paraffinic hydrocarbons by the following processes : production of hydrogen by the action of steam on the light gaseous fraction, production of polymer from the heavy gaseous fraction then hydrogenation of the polymer, isomerization of the light liquid fraction in the presence of hydrogen.

B. L. Evering and A. P. Lien, assrs to S.O.C. Indiana. U.S.P. 2,400,985, 28.5.46. V. Voorhees, assr to S.O.C. Indiana. U.S.P. 2,400,986, 28.5.46. Hydrofluoric acid is employed to desalt crude petroleum.

H. L. Cupples, assr to U.S.A. U.S.P. 2,401,053, 28.5.46. An apparatus to determine the surface tension of an unknown liquid by the method of maximum bubble pressure.

O. M. Reiff and J. D. Zech, assrs to Socony Vacuum Oil Co. U.S.P. 2,401,104, 28.5.46. A plastic oxy-aromatic petroleum wax is obtained by heating a chlorinated petroleum wax with phenol or naphthol or diphenyl ether in the presence of a Friedel-Crafts catalyst then dechlorinating with caustic soda.

W. A. Schulze and G. H. Short, assrs to Phillips Petroleum Co. U.S.P. 2,401,114, 28.5.46. Low-boiling diolefins are separated from hydrocarbon mixtures by absorption on dry powdered cuprous halide.

M. Berliney, G. A. Bowden, and J. T. Hohnstine, assrs to Boyle-Midway Inc. U.S.P. 2,401,217. A wax coating composition consisting approximately of 73% paraffin wax, 18% ester type rosin, and 9% stearic acid.

W. Hull, assr to American Cyanamid Co. U.S.P. 2,401,246, 28.5.46. A monocyclic terpene is converted to *p*-cymene in the presence of a supported oxide catalyst.

ABSTRACTS

E. M. Nygaard, assr to Socony Vacuum Oil Co. U.S.P. 2,401,267-9, 28.5.46. The preparation of nitrolic acids and pseudonitroles from mononitroparaffins.

O. M. Reiff and D. W. Andrus, assrs to Socony Vacuum Oil Co. U.S.P. 2,401,273, 28.5.46. An additive for a viscous oil comprising an oil-soluble metal hydrosulphide of a basic polyvalent-metal salt of an alkyl substituted aromatic hydrocarbon compound.

C. E. Welling, assr to Phillips Petroleum Co. U.S.P. 2,401,282, 28.5.46. Methanol is used as the azeotropic liquid in the separation of *cyclopentene from piperylene*.

R. E. Burk and E. C. Hughes, assrs to S.O.C. Ohio. U.S.P. 2,401,334, 4.6.46. Naphtha is desulphurized by contact with a spent Cr_2O_3 , Al_2O_3 catalyst then aromatized with a fresh charge of new catalyst.

H. H. Meier, assr to S.O. Dev. Co. U.S.P. 2,401,363, 4.6.46. A combined catalytic and thermal cracking process to produce aviation gasoline base.

C. E. Welling, assr to Phillips Petroleum Co. U.S.P. 2,401,444, 4.6.46. Acetylene is removed from a gaseous mixture containing olefins by hydrogenation in the presence of borosilicate glass.

V. L. Chechot and L. S. Howe, assrs to Atlantic Refining Co. U.S.P. 2,401,614, 4.6.46. Before removing solid material from an oil solution of an alkaline earth metal sulphonate a small amount of an aliphatic alcohol, glycol, or glycol ether is added to reduce the viscosity.

V. Haensel and V. N. Ipatieff, assrs to U.O.P. Co. U.S.P. 2,401,636, 4.4.46. The olefin content of an unsaturated gasoline is reduced by the action of a precipitated silica-alumina catalyst under suitable conditions.

F. W. Leffer, assr to U.O.P. Co. U.S.P. 2,401,649, 4.6.46. A multi-stage process including reforming, alkylation, and catalytic olefin conversion to convert non-aromatic oil into low-boiling aromatics.

G. B. Zimmerman, assr to U.O.P. Co. U.S.P. 2,401,678, 4.6.46. A recycle process for isomerization of *n*-butane.

L. H. Flett and G. C. Joone, assrs to Allied Chemical and Dye Corpn. U.S.P. 2,401,726, 11.6.46. A detergent composition containing an alkali-metal salt of a long chain (12–18 C atoms) monoalkyl ester of sulphuric acid and a water soluble salt of a monoalkyl ester of sulphoacetic acid.

A. D. Green, assr to S.O. Dev. Co. U.S.P. 2,401,754, 11.6.46. A process of finishing solid high mol. wt. polymers prepared from an *iso*olefin at below -40° C in the presence of a Friedel–Crafts catalyst.

S. H. Hastings and B. B. Turner, assrs to S.O. Dev. Co. U.S.P. 2,401,758, 11.6.46. Acetylene is removed from its mixture with diolefins by dehydrogenation in the presence of a diluent.

H. S. Taylor and J. Turkevich, assrs to M. W. Kellogg Co. U.S.P. 2,401,802, 11.6.46. Mono-olefins are converted to diolefins by contact at an elevated temperature with a granular alumina catalyst having deposited thereon an oxide of metal of the left-hand column of groups IV, V, and VI of the periodic table in a non-oxidizing atmosphere containing steam.

S. D. Sumerford, assr to S.O. Dev. Co. U.S.P. 2,401,846, 11.6.46. A method of activating the catalyst with steam and a gaseous paraffin prior to catalytic dehydrogenation of olefins.

G. B. Arnold and H. V. Atwell, assrs to The Texas Co. U.S.P. 2,401,852, 11.6.46. Aromatics are extracted from a straight or cracked naphtha using water containing up to 25% of ammonia or aliphatic amines at $300-450^{\circ}$ F under pressures up to 1300 lb.

L. A. Clarke, assr to The Texas Co. U.S.P. 2,401,859, 11.6.46. A multi-stage process of manufacture of gasoline including polymerization, alkylation, and isomerization.

M. H. Gorin, E. Gorin, L. G. Sharp, and I. H. Welensky, assrs to Socony Vacuum Oil Co. U.S.P. 2,401,865, 11.6.46. An olefin and a light *iso*paraffin are converted to high octane-number hydrocarbons by contact with a catalyst comprising an association

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of an acidic oxide and an amphoteric oxide at $275^{\circ}-500^{\circ}$ C at a pressure in excess of 100 lb.

J. P. Jones, assr to Phillips Petroleum Co. U.S.P. 2,401,872, 11.6.46. A multistage process for converting ethane to butadiene.

W. A. Schulze and W. N. Axe, assrs to Phillips Petroleum Co. U.S.P. 2,401,884, 11.6.46. Treatment of boron fluoride catalysts prior to use in alkylation.

W. C. Asbury and M. W. Swaney, assrs to S.O. Dev. Co. U.S.P. 2,401,896, 11.6.46. A process for separating alkyl and acetylenes from hydrocarbon mixtures.

F. E. Frey, H. J. Hepp, and G. H. Morey, assrs to Phillips Petroleum Co. U.S.P. 2,401,922, 11.6.46. Promotion of the thermal scission and polymerization of light hydrocarbons by addition of an alkylene oxide.

M. H. Gorin, assr to Socony Vacuum Oil Co. U.S.P. 2,401,925, 11.6.46. Isoparaffins are alkylated with ethylene using aluminium bromide in solution in a paraffinic solvent.

A. B. Hersberger, assr to The Atlantic Refining Co. U.S.P. 2,401,933, 11.6.46. Lubricating oils are synthesized by polymerization of a propylene *iso*butylene mixture at -10° to $+35^{\circ}$ C in the presence of a Friedel-Crafts catalyst in a lower alkyl halide.

C. J. Pederson and R. O. Bender, assrs to du Pont de Nemours & Co. U.S.P. 2,401,957, 11.6.46. An inhibitor for gasoline and kerosine consisting of an alkyl derivative of 2-aminomethyl-4-aminophenol.

R. A. Salathiel, assr to S.O. Dev. Co. U.S.P. 2,401,966, 11.6.46. A process and agent for breaking petroleum emulsions.

W. D. Seyfried and S. H. Hastings, assrs to S.O. Dev. Co. U.S.P. 2,401,973, 11.6.46. Butylene is dehydrogenated to butadiene using magnesium oxide-iron oxide catalyst.

J. I. Wasson and G. W. Duncan, assrs to S.O. Dev. Co. U.S.P. 2,401,993, 11.6.46. A corrosion resistant composition consisting of a tertiary butyl ether of *o*-tertiary butyl *p*-cresol and a small proportion of "lorol" amine salicylate.

H. O. Folkins and C. M. Thacker, assrs to Pure Oil Co. U.S.P. 2,402,034, 11.6.46. A process for cracking hydrocarbons in the presence of a small amount of *p*-dibromobenzene.

V. N. Ipatieff and L. Schmerling, assrs to U.O.P. Co. U.S.P. 2,402,051, 11.6.46. A process of manufacturing catalysts from aluminium halide and phosphoric acid.

J. A. Patterson, assr to Standard Alcohol Co. U.S.P. 2,402,077, 11.6.46. Method of purifying *iso*propyl alcohol obtained by the treatment of propylene with sulphuric acid.

L. Schmerling and A. M. Durinski, assrs to U.O.P. Co. U.S.P. 2,402,092, 11.6.46. Aromatic hydrocarbons are alkylated with an alkyl halide in the presence of a silica catalyst.

L. F. Hatch, D. E. Adelson, and B. O. Blackburn, assrs to Shell Dev. Co. U.S.P. 2,402,113, 11.6.46. Monomeric butadiene is stabilized with 4-tert.-butyl catechol.

L. A. Clarke, assr to The Texas Co. U.S.P. 2,402,126, 18.6.46. Process for the continuous alkylation of *iso*butane with ethylene in the presence of an aluminium halide-hydrocarbon complex liquid catalyst.

G. Egloff, assr to U.O.P. Co. U.S.P. 2,402,243, 18.6.46. Styrene is obtained by reacting benzene with acetylene in the presence of a Friedel-Crafts catalyst on an inert granular porous support.

F. E. Frey, assr to Phillips Petroleum Co. U.S.P. 2,402,277, 18.6.46. A thermal process for the conversion of trimethylethylene to *iso*prene.

A. Lazar and J. C. Carter, assrs to Tide Water Associated Oil Co. U.S.P. 2,402,288, 18.6.46. A purified naphthenic base oil is sulphonated and the oil soluble sulphonic acids are converted to polyvalent metal sulphonates. The product is used as an oxidation inhibitor for lubricating oils. A. C. Stoneman. U.S.P. 2,402,304, 18.6.46. A method of treating finely-divided activated carbon to remove the particles of lowest density, thereby increasing the adsorptive activity of the residual product.

W. K. Griesinger and E. H. Engelking, assrs to The Atlantic Refining Co. U.S.P. 2,402,325, 18.6.46. A method of producing an oil solution of a basic alkaline-earth metal sulphonate.

E. C. Herthel, assr to Sinclair Refining Co. U.S.P. 2,402,328, 18.6.46. Catalytic alkylation of *iso*butane.

J. E. Smith and P. J. Mitchell, Jr., assrs to Du Pont de Nemours. U.S.P. 2,402,351, 18.6.46. An aqueous emulsion of paraffin wax containing an aluminium salt and a modified protective colloid for use as a water repellent composition.

T. H. Whaley, Jr., assr to Phillips Petroleum Co. U.S.P. 2,402,355, 18.6.46. A design for a dispensing system for a volatile liquid.

R. B. Mason, assr to S.O. Dev. Co. U.S.P. 2,402,423, 18.6.46. Improvements in the continuous catalytic reduction of aromatic nitro-compounds to the corresponding amines.

H. H. Meier, assr to S.O. Dev. Co. U.S.P. 2,402,425, 18.6.46. Naphtha is subjected to thermal conversion and after elimination of oxygen and organic peroxides is extracted with sulphur dioxide.

J. J. Owen, assr to S.O. Dev. Co. U.S.P. 2,402,439-40, 18.6.46. Metal sulphides are used as catalysts with hydrogen to reduce aromatic nitro-compounds to amines.

A. H. Batchelder and F. S. Rollins, Jr., assrs to California Research Corpn. U.S.P. 2,402,487, 18.6.46. A foam inhibited oil is obtained by the addition of a small amount of a short chain nitro aliphatic alcohol to a lubricating oil.

B. S. Greensfelder and W. H. Peterson, assrs to Shell Dev. Co. U.S.P. 2,402,493, 18.6.46. A selective hydrogenation process to produce *mono*olefin compounds.

O. M. Reiff and J. J. Giammaria, assrs to Socony Vacuum Oil Co. U.S.P. 2,402,566, 18.6.46. A rubber-like wax substituted aromatic compound is obtained by the reaction between chlorinated wax and phenol, naphthols, and diphenyl ether in the presence of a Friedel-Crafts catalyst.

W. P. Hawthorne, assr to Socony Vacuum Oil Co. U.S.P. 2,403,922, 16.7.46. A hydrofluoric acid alkylation process.

C. S. Kuhn, Jr., assr to Socony Vacuum Oil Co. U.S.P. 2,403,929, 16.7.46. Hydrofluoric acid alkylation including a reforming stage.

C. S. Kuhn, Jr., assr to Socony Vacuum Oil Co. U.S.P. 2,403,930–1, 16.7.46. Hydrofluoric acid alkylation using ethylene, and sulphuric acid alkylation using ethylene, each catalyst being modified by addition of a specific salt.

W. N. Axe, assr to Phillips Petroleum Co. U.S.P. 2,403,963, 16.7.46. Formation of phenylbutenes from benzene and butadiene in the presence of a hydrated boron fluoride catalyst.

B. S. Friedman, assr to U.O.P. Co. U.S.P. 2,403,972, 16.7.46. Sulphuric acid containing a silver compound such as the sulphate, oxide, or carbonate is used to extract aromatics from its mixture with other saturated hydrocarbons.

J. C. Bailie, L. Heard, and R. V. Shankland, assrs to S.O.C. Indiana. U.S.P. 2,404,024, 16.7.46. A metal oxide catalyst for reforming naphtha.

G. R. Gilbert, assr to S.O. Dev. Co. U.S.P. 2,404,050, 16.7.46. Reforming of alkylate at $750-1100^{\circ}$ F and 100-600 lb pressure to improve octane number.

E. Gorin, assr to Socony Vacuum Oil Co. U.S.P. 2,404,055, 16.7.46. Manufacture of aluminium halide catalysts.

E. Gorin and A. G. Oblad, assrs to Socony Vacuum Oil Co. U.S.P. 2,404,056, 16.7.46. Manufacture of *iso*prene from propylene.

J. P. Hamilton and C. F. Jones, assrs to S.O. Dev. Co. U.S.P. 2,404,061, 16.7.46. A system of pre-coat filtration for viscous liquids containing solids and tarry materials. J. J. Heigl and J. A. Wilson, assrs to S.O. Dev. Co. U.S.P. 2,404,064, 16.7.46. An apparatus for investigating absorption spectra of substances.

C. E. Jahnig, assr to S.O. Dev. Co. U.S.P. 2,404,071, 16.7.46. A method of recovery of finely-divided particles from high temperature gases.

T. B. McCulloch, assr to S.O. Dev. Co. U.S.P. 2,404,080, 16.7.46. Normal parafins are isomerized by the action of sulphuric acid at $300-500^{\circ}$ F.

A. E. Robertson, assr to S.O. Dev. Co. U.S.P. 2,404,094, 16.7.46. A motor fuel consisting of 80-98% methyl alcohol and a minor proportion of a 3-5 carbon atom paraffin or naphthene sufficient to raise the Reid vapour pressure of the blend to 13 lb at 100° F.

L. Schmerling, assr to U.O.P. Co. U.S.P. 2,404,100, 16.7.46. A naphthene hydrocarbon is alkylated with an alkyl halide in the presence of an aluminium halidenitroparaffin catalyst.

R. M. Shepardson, assr to S.O. Dev. Co. U.S.P. 2,404,104, 16.7.46. A solvent raffanate of a narrow cut naphtha fraction containing ethylcyclohexane is dehydrogenated in the presence of a catalyst and the ethylbenzene product is recovered.

W. N. Axe, assr to Phillips Petroleum Co. U.S.P. 2,404,120, 16.7.46. An alkyl aromatic is obtained by the reaction between an aromatic compound and a normal 1:3-diolefin in the presence of a catalyst followed by hydrogenation.

V. Scarth, assr to Phillips Petroleum Co. U.S.P. 2,404,253, 16.7.46. Extractive distillation of a C_4 cut with furfural.

G. B. Zimmerman, assr to U.O.P. Co. U.S.P. 2,404,340, 16.7.46. Propylene is polymerized and then the polymer is isomerized and then employed to alkylate a suitable hydrocarbon.

E. A. Evans and C. C. Wakefield & Co., Ltd. B.P. 583,551, 1.1.47. Lubricating oil compositions.

Du Pont de Nemours & Co. B.P. 583,804, 15.1.47. Polymerization or interpolymerization of mono-olefins. B.P. 583,850, 15.1.47. Polymerization or interpolymerization of ethylene.

W. B. Heaton and Trinidad Leaseholds, Ltd. B.P. 583,803, 15.1.47. Prevention of knock in I.C. engines.

I.C.I., Ltd. B.P. 583,805, 15.1.47. Polymerization or interpolymerization of mono-olefins.

S.O.C. California. B.P. 583,995, 15.1.47. Electromagnetic pick-up unit for determining the intensity of engine detonation.

J. C. Arnold, assr to S.O.Dev. Co. B.P. 584,121, 22.1.47. Method for the separation of propylene from ethylene.

I.C.I., Ltd., R. B. Richards, J. R. Myles, and D. Whittaker. B.P. 584,324, 22.1.47. Ethylene interpolymers also I.C.I., Ltd. (Du Pont de Nemours). B.P. 584,309, 22.1.47. Production of polymer products of ethylene.

Shell Dev. Co. B.P. 584,256, 22.1.47. Production of phenolic compounds.

G. R. N.

PRODUCTS.

Chemistry and Physics.

418. On the Course of the Reaction at 100° C in the System Paraffin/Oxygen. D. J. W. Kreulen. J. Inst. Petrol., 1946, 32, 656.—The oxidation of solid paraffin has been investigated. The quantities of peroxides and aldehydes formed are proportional to time, while the quantity of acids is a quadratical function of time. If copper is present the peroxides are destroyed and an increase in the quantity of aldehydes is observed. In conclusion, the results obtained with white oils, xylene, and solid paraffin are compared. A. H. N.

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ABSTRAC

419. Experiments on the Production of Toluene from Coal Tar Products and Other Sources. C. M. Cawley, J. H. G. Carlile, H. E. Newall, and F. E. T. Kingman. J. Inst. Petrol., 1946, 32, 660.—Great Britain's large toluene requirements during the war were met by increased production from coke-oven and gas-works benzole and by importation from the United States, where production from petroleum was carried out on a large scale. At the beginning of the war, however, it was uncertain whether sufficient toluene would be available, and a study was made of some of the ways of making this substance from coal-tar products—benzene, xylene, cresol, and naphthalene. Particular attention was given to the possibility of preparing toluene by the hydrogenation of cresol, and a continuous process working at a pressure of 10-20 atm and a temperature of $430-440^{\circ}$ C was developed to a semi-technical scale (120 g.p.d.). A laboratory examination was also made of the cyclization of *n*-heptane. A. H. N.

420. The Vaporization of Fuels for Gas Turbines. Part I. The Bubble-Points and Dew-Points of Liquid Hydrocarbon Fuels. B. P. Mullins. J. Inst. Petrol., 1946, 32, 703.-The search for new and improved forms of gas-turbine combustion chambers naturally turns towards systems with perfect fuel atomization, an ideal that can be realized by pre-vaporization of the fuel. The evaluation of the vaporization characteristics of gasturbine fuels described in this paper is the first step towards achieving this ideal. A review of the empirical methods devised during the past twenty-five years for determining the bubble-points and dew-points of liquid hydrocarbon fuels is given, and these are applied to standard fuels. Some practical determinations involving the preparation of "equilibrium solutions" by the method of Wilson and Barnard were also undertaken. Finally, a theoretical method for calculating bubble-points and dewpoints, depending on a knowledge of the true boiling-point distillation curve of the fuel in question, was developed and applied to standard fuels. The calculations cover a static pressure range of 10^{-2} to 10 atm and have been extended to air-fuel ratios of 0:1 to 20:1. The main results for an aviation spirit, a kerosine, and a gas oil are Ă. H. N. presented in the form of nomograms.

421. Mechanism of the Catalytic Oxidation of Ethylene. (1) Experiments Using a Flow System. G. H. Twigg. *Proc. Roy. Soc.*, A, 1946, 188, 92.—A description of experiments made using a flow system to determine the mechanism of the catalytic oxidation of ethylene on a silver catalyst. The effect of time of contact, gas concentration, and temperature were investigated. The products of reaction were ethylene oxide, carbon dioxide, and water. Carbon dioxide appeared to be formed : (a) by direct oxidation of the ethylene, not via ethylene oxide, and (b) by the further oxidation.

Isomerization of ethylene oxide to acetaldehyde by the catalyst in absence of oxygen was also examined, and by comparison with the oxidation of ethylene oxide it was shown that this latter reaction proceeds to a large extent, and possibly entirely, through a preliminary isomerization of the ethylene oxide to acetaldehyde. The rate of oxidation of the latter was extremely rapid and no trace of it was found during the oxidation of ethylene or ethylene oxide. Ethylene oxide forms an involatile deposit on the catalyst, oxidized by oxygen, so that during oxidation reactions the quantity of it on the catalyst was kept low.

The kinetics of the oxidation of ethylene, *i.e.*, rate of reaction proportional to the oxygen concentration and slightly dependent on the ethylene pressure, are consistent with the view that ethylene reacts with oxygen adsorbed on the catalyst and that the slowest step in the whole series of reactions is the rate of adsorption of the oxygen. An energy of activation of about 27 kcal was found for the production of ethylene oxide, and slightly less for the production of carbon dioxide and consumption of oxygen. T. M. B. M.

422. Mechanism of the Catalytic Oxidation of Ethylene. (2) Reactions Between Ethylene, etc., and Chemisorbed Oxygen Monolayers. G. H. Twigg. *Proc. Roy. Soc.*, A, 1946, 188, 105.—Experiments have been carried out at temperatures of 263° C and higher between oxygen adsorbed as atoms on the silver catalyst, and ethylene, ethylene oxide, and acetaldehyde.

The course of reaction was followed by measuring the change in pressure, and

analyses of the products were made by micro-fractionation of the gases at low temperatures.

In the reaction of ethylene with an oxygen-covered catalyst, the absence of an induction period in the pressure-time curve showed that oxidation of ethylene to carbon dioxide and water by a route not through ethylene oxide is possible. The reaction of acetaldehyde with the oxygenated catalyst was too fast to measure. The reactions of ethylene oxide were found to be complex and occurred both with the oxygenated and the clean catalyst. On a clean catalyst, ethylene oxide was simultaneously isomerized to acetaldehyde and converted back to ethylene and adsorbed oxygen; the acetaldehyde and adsorbed oxygen then reacted to form carbon dioxide and water.

Both ethylene oxide and acetaldehyde, but not ethylene, were adsorbed with decomposition to form a non-volatile layer on the catalyst. This was composed of carbon, hydrogen, and possibly oxygen, combined in indefinite and varying proportions.

The kinetics of the reaction between ethylene and the adsorbed oxygen layer were measured. Throughout the course of any one reaction, the rate of oxidation to carbon dioxide was proportional to the square of the concentration of adsorbed oxygen, but the velocity constant depended on the initial concentration. The apparent energy of activation was 10 kcal.

It is thought that when ethylene reacts with a single adsorbed oxygen atom, ethylene oxide is produced, and that with a pair of adsorbed oxygen atoms, intermediates such as formaldehyde are produced which react rapidly to form carbon dioxide and water. T. M. B. M.

423. Mechanism of the Catalytic Oxidation of Ethylene. (3) The Reactions Between Ethylene and Oxygen in a Static System. G. H. Twigg. Proc. Roy. Soc., A, 1946, 188, 123.—Static experiments have been carried out between ethylene and oxygen on the silver catalyst at different pressures and temperatures, and the rates of the several reactions occurring were determined. It was found at 263° C that: (i) the rate of oxidation of ethylene to ethylene oxide is proportional to the ethylene pressure (a) and to the first power of the concentration (b) of adsorbed oxygen on the catalyst. (ii) The rate of the direct oxidation of ethylene to carbon dioxide is proportional to (a) and to the square of (b). (iii) The rate of oxidation of ethylene oxide is proportional to (a) and independent of (b).

The kinetic equations for the course of reaction with time, although incapable of analytical solution, were integrated by means of the Bush differential analyser, the numerical constants being fitted to one series of experiments. The goodness of fit and the accuracy of the predictions were confirmation of the kinetics deduced.

These results confirm previous findings that the main steps in the reactions are: (i) chemisorption of oxygen as atoms on the catalyst surface, (ii) reaction of gaseous or weakly adsorbed ethylene either with one oxygen to form ethylene oxide, or with two atoms to form products which are oxidized rapidly to carbon dioxide, and (iii) isomerization of ethylene oxide to acetaldehyde followed by the rapid oxidation of this to carbon dioxide. Energies of activation were measured for these steps.

An attempt was made to measure directly the concentration of oxygen adsorbed on the catalyst during reaction, by cleaning it with hydrogen after pumping out the reaction mixture; a value of 0.31 was found which was in fair agreement with that expected from the machine solutions. T. M. B. M.

424. Equilibrium Constants of Some Reactions Involved in the Production of 1:3-Butadiene. F. G. Brickwedde, M. Moskow, and J. G. Aston. Bur. Stand. J. Res. Wash., November 1946, 37 (5), 263.—Thermodynamic functions including free energy, enthalpy, entropy, and specific heat for butadiene, benzene, cyclohexane, ethane, ethylene, ethyl alcohol, and water and for the elements carbon (graphite), hydrogen, and oxygen are given. From these are calculated and tabulated values of equilibrium constants for reactions of interest in connection with the production of 1:3-butadiene for synthetic rubber. Table values and available experimental data on equilibrium constants, gaseous specific heats, and entropies are compared. Hydrocarbon cracking is discussed and the importance of reaction rates in determining the amounts of reaction products is noted. T. M. B. M. **425.** Burnett Apparatus Used for Gas-Deviation Determinations. E. N. Armstrong. *Oil Gas J.*, 7.12.46, **45** (31), 82.—An apparatus for the determination of the deviation of natural gas from Boyle's law, and method of operation is described.

The apparatus includes a very accurate piston gauge with weights ranging from 1/100 lb to 500 lb to total 4000 lb, a steel diaphragm cell for accurate balancing of pressures, and a steel bomb with two chambers for obtaining pressure ratios, and auxiliary equipment.

Any gravity of gas can be tested at any pressure and temperature from 0 to 4000 lb and minus 20° to 400° F respectively.

The apparatus measures a series of pressures in order to establish pressure ratios at a constant temperature.

Representative gas samples, free from condensed liquids, must be drawn, temperatures should be arranged accordingly.

Results on a test run at 70° F on natural gas of 0.593 specific gravity are tabulated.

G. A. C.

426. Photochemical Polymerization of Butadiene. D. H. Volman. J. Chem. Phys., 1946, 14, 467.-Investigations were made on mercury photosensitized polymerization of butadiene and mixtures of butadiene and acetone in the gas phase, and the photochemical reactions in solutions of butadiene and acetone in hexane. Metal mirror experiments have shown the absence of hydrogen atoms and the presence of alkyl radicals at low pressures. The mechanism proposed for butadiene vapour postulates an activated butadiene molecule produced by collision with activated mercury and competition between deactivation by collision, predissociation into free radicals and a collisional process to give hydrogen gas. The polymerization chain proceeds by a mechanism involving either free radicals or hydrogen atoms. In the presence of acetone vapour, the rate is increased and the increase is directly proportional to the number of free radicals coming from acetone, indicating that polymerization chains are not broken by bimolecular gas phase reaction between free radicals. For butadiene alone at 53-mm pressure and 43° C the quantum yield was 0.24. The average number of molecules reacting per free radical formed was calculated to be between 3 and 8. The liquid solution results are explained on the basis of a modified Frank-Rabinowitch hypothesis for the primary photochemical process. By collision with hexane, the activated acetone molecules become deactivated and react with acetone to yield unsaturated compounds and with butadiene to initiate polymerization. The following kinetic equation is developed for the rate of polymerization,

$$dP/dt = (kI_{abs}/I_0)(n[C_4H_6] - [(CH_3)_2CO]),$$

where n is the average number of molecules reacting per free radical. n is taken equal to 4. J. T.

427. Physical Constants of Low-Boiling Hydrocarbons and Miscellaneous Compounds. W. S. Hanna and R. Matteson. Oil Gas J., 11.1.47, 45 (36), 61.—Physical constants, selected as far as possible from A.P.I. Project 44 have been compiled; representing the fourth revision of the table originally commenced in 1937.

Molecular weights and carbon hydrogen ratios are as previously reported; but changes have been made in the melting-point and boiling-point values. Minor revisions have been made in the critical temperature data. Density, gas-law deviation factors, and specific heat values have been revised, as also have the figures for air for combustion, inflammability limits, aniline point, and octane number.

A bibliography of 91 references is also given.

G. A. C.

428. Plastic Flow, Creep, and Stress Relaxation. Part I. Plastic Flow. C. Mack. J. appl. Phys., 1946, 17, 1086.—Plastic substances are considered to be composed of units of flow with various yield values. It is shown that in this case the product of the strain rate and viscosity is equal to the sum of the differences between the applied stress and the yield values. This relationship can be applied to any plastic system free of elastic after-effect and expresses their mechanical properties in terms of a coefficient of viscosity which is independent of the stress applied. With the proper choice of the distribution of yield values any kind of relation between stress and strain rate can be established. The relationship is applied to plastic flow which is defined as a deforma-

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tion mechanism having a curvilinear relationship between stress and rate of deformation and a constant rate of deformation at constant stress. Equations are given for the coefficient of viscosity of such systems and for the relaxation of stress at constant deformation as a function of time. A. H. N.

429. Plastic Flow, Creep, and Stress Relaxation. Part II. Creep. C. Mack. J. appl. Phys., 1946, 17, 1093.-The general equation covering the deformation of plastic substances given in Part I is applied to creep. Creep is defined as a mechanism of deformation for systems which have a curvilinear relationship between stress and strain rate and a curvilinear relationship between strain and time at constant stress. Creep is connected with changes in the internal structure of a plastic substance and results in an increase in strength of such materials through work-hardening. Equations are derived which give the stress as a function of strain rate and time (time-hardening), as a function of strain rate and strain (strain-hardening) and as a function of strain rate, strain, and time. The difference between time-hardening and strain-hardening is discussed. Expressions are given for the coefficients of viscosity of such systems which are independent of the stress applied. The relaxation of stress at constant strain is discussed, and it is shown that the stress relaxation depends upon the history of the substance under test. The concept of creep is also applied to thixotropic systems which are considered as cases of work-softening. A. H. N.

430. Plastic Flow, Creep, and Stress Relaxation. Part III. Creep and Elastic After-Effect. C. Mack. J. appl. Phys., 1946, 17, 1101.—A large number of substances show the phenomenon of elastic after-effect, and part of their deformation recovers on unloading as a function of time. This portion of the deformation at constant stress has a strain rate which decreases with time and is therefore comparable to creep. Expressions are given for the strain-time relationships of such systems, and the process of stress relaxation at constant strain is discussed. The equations given in connection with plastic flow, creep due to work-hardening, thixotropy, and creep in combination with elastic after-effect are applied to data given in the literature, and it is shown that these equations suffice to describe the deformation and relaxation mechanisms of a variety of materials such as metals, clay soil, food products, acrylic acid polymeride, polyvinyl chloride, cellulose acetate, manila ropes, paper laminates, phenolic moulding compounds, rubber, asphalt, and bituminous pavements. A. H. N.

431. Tendency to Smoke of Organic Substances on Burning. Part II. Smoke Production and Burning Characteristics of Hydrocarbon Gels. F. H. Garner, T. G. Hunter, and A. E. Clarke. J. Inst. Petrol., 1946, 32, 643.—In a previous paper a description has been given of the tendency of organic substances to smoke on burning and in the present paper the smoke production during the burning of hydrocarbon gels has been investigated. The weight of smoke formed has been determined and the obscuring power of the smoke cloud measured by an optical density method. The burning characteristics of the gels were also examined. These burning characteristics have been assessed by determining the unburned residue resulting from the combustion of a constant weight of gel with a constant burning area exposed, together with the time of burning and maximum and mean flame heights. The effect of the following variables on the above measurement has been investigated and discussed in detail : (1) Chemical composition of the hydrocarbon base; (ii) Volatility of the hydrocarbon base; (iii)

For reduction of smoke formation, the composition of the hydrocarbon base was found to be most important, while the volatility was equally important in controlling the burning characteristics. The viscosity of the gel had no apparent effect on smoke production. A. H. N.

432. Thermodynamic Properties of Hydrocarbons. I. Theoretical Aspects of the Calculation of Thermodynamic Data from Spectroscopic Data. T. Reis. Rev. Inst. Frang. Pétrole, 1946, 1, 33.—This paper reviews the published formulæ dealing with statistical mechanics, infra-red and Raman spectra and symmetry in polyatomic molecules. The function of distribution, as regards polyatomic molecules, is dealt with in greater detail. The case of molecules with and without internal rotation is considered and the part played by rotational and vibrational factors in the distribution

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function is tabulated. Potential barriers for the case of hindered internal rotation are explained and numerical values, selected from the literature, are given for different compounds at varying temperatures. The calculation of latent and specific heats, entropies, free energies, and equilibrium constants for compounds of various types is demonstrated. As a detailed example the equilibrium constants for the system ethaneethylene are calculated for temperatures of 653, 723, and 863° K.

II. Numerical Data and Examples. N. Tcherkezoff. *Ibid.*, 1946, 1, 50.—In this section a selection has been made of the values published in the literature for constants such as the heat of formation, free energy, entropy, and heat of vaporization of various hydrocarbons. The figures are tabulated, as are the general thermodynamic formula applicable to various hydrocarbon types. Detailed consideration is given to the calculation of the free energies of some of the more important paraffins, the discussion in each case being based on previously published figures. V. B.

433. Thermodynamic Properties of Hydrocarbons. II. Numerical Data and Examples. N. Tcherkezoff. Rev. Inst. Franc. Petrole, 1946, 1, 107.—This is a continuation of a previous paper (see Abstract No. 432/47). The thermodynamic properties of olefinic, acetylenic, and cyclic hydrocarbons are discussed on the basis of published data. Some examples are given of the application of free energy calculations to polymerization, isomerization, cracking, and alkylation reactions. The paper includes 11 tables giving properties such as critical constants, heats of combustion and formation, equilibrium constants for some of the principal reactions and other thermodynamic data for numerous hydrocarbons of all types. V. B.

434. Water and *n*-Hexane. D. L. Katz, G. H. Hanson, H. S. Kemp, and E. G. Opdyke. *Refiner*, 1946, 25, 419.—Experimental atmospheric boiling and condensing film coefficients obtained on a laboratory unit are presented for water and *n*-hexane. Inside film coefficients for condensing steam are given. The temperature variations around and along the boiling and condensing tubes are illustrated. G. R. N.

Analysis and Testing.

435. The Four-Ball Oil Tester. C. F. Krienke (trans. by E. J. Barth). Refiner, 1946, 25, 467.—Several tests on three different oils were made on a four-ball test machine—straight run mineral oil, a 100% fatty oil, and a mineral oil containing elementary sulphur in solution. The results were somewhat scattered. When enough tests are made, however, wear values and seizure constants are obtained which show definite trends and are concordant. Wear tests show that sulphur exerts an extremely favourable anti-wear action on metallic surfaces, far surpassing a mineral oil and even fatty oils, which have been though of as being good oils. G. R. N.

436. 50° -100° **A.P.I.** Versus Specific Gravity. W. L. Nelson. Oil Gas J., 11.1.47, **45** (36), 89.—No. 126 in the Refiner's Notebook series gives a chart showing conversion of degrees A.P.I. to specific gravity. The range is from 50° to 100° A.P.I. (0.7796 to 0.6115 specific gravity) in tenths of degrees. G. A. C.

437. New Methods for Determining the Anti-Knock Values of Aircraft Fuels. M. L. Thaler. Bull. Assoc. Franç. Tech. Pét., 1946, (60), 39.—A review of methods available for measuring O.N.'s above 100. War-time developments in the U.S. and U.K. are described with particular reference to the "F.4" and "Performance Number" methods of fuel evaluation. Some German results on the injection of water and of alcohols (methyl and ethyl) on the maximum power output of supercharged engines are given. These show that the most effective instant for the injection of water is 120–140° before top dead centre on the compression stroke. On aircraft engines, using direct fuel injection with alcohol introduced into the induction manifold, it was possible by the use of mixtures of methyl alcohol (aqueous) and 87 O.N. fuel to obtain a performance equivalent to that yielded by 100 O.N. fuel, without increase of fuel consumption. The results of these German tests on gasoline/alcohol/water blends are presented graphically. The occurrence of detonation in these tests was detected by a rise in the temperature of the engine coolant. French research on fuel problems has

been hampered, since the end of the war, by the lack of test equipment, the few engines available being engaged in routine testing. It is urged that the French industry should adopt U.S. test methods and correlate these with the performance of French aeroengines; only if this were to show wide variations between laboratory results and those in practice should French test methods be developed. V. B.

438. Specimen Study of a Hydrocarbon Mixture by the Raman Effect. —. Delwaulle, F. Francois, and J. Wiemann. *Chim. et Ind.*, 1946, 56, 292.—A synthetic gasoline was fractionated into 10 cuts boiling in the range 40–159° C. Each cut was subjected to spectroscopic (Raman) analysis. The principal saturated and unsaturated hydrocarbons present in each fraction were identified by their characteristic bands. The saturated hydrocarbons are all straight chain compounds; if any branch chain compounds are present their amount is small. Among the unsaturated hydrocarbons the lower members are straight chain but branching increases with a rise in mol. wt. Chemical analysis shows that the olefin content decreases with a rise in b.p. V. B.

439. Molecular Weights in Practice and Theory. **1.** Practice. **2**(2). Physical Methods. A. V. Brancker. *Petroleum*, 1946, **9**(12), 274.—The methods discussed include ebullioscopic methods (Beckman and Menzies-Wright) and the Rast camphor method for substances of low and medium mol. wt. For polymeric substances the methods described are the viscosity method, the osmotic method and finally the ultra-centrifuge method as developed by Svedberg. Full references to the appropriate literature are given. K. C. G. K.

440. Crankcase Oil Ageing Tests (2). M. Freund. Petroleum, 1946, 9 (11), 255.— Details are given of a laboratory method of test suitable for the determination of foreign solids, hard asphalts, and petroleum resins in used crankcase oil using one and the same sample. Oil-dilution must always be taken into consideration in the case of combustion engines. In such cases, the oil-samples must be freed from heavy fuel-ends as far as possible. For reproducible results, oils drawn from the crankcase should be stored for an equal period of time prior to examination. They should be vigorously shaken at 150°C and all samples should be weighed at the same time, both because of the settling of suspended sludge and the effect of auto-oxidation and polymerization. Samples should be moisture free. K. C. G. K.

441. Crankcase Oil Ageing Tests (3). M. Freund. *Petroleum*, 1946, **9** (12), 278.— The determination of the neutralization numbers of used crankcase oils and the effect of sludge is discussed. To demonstrate the latter effect three methods of titration are used: (1) Titration of the original used oil in a glass beaker; (2) Titration after centrifuging the used oil dissolved in alkali blue mixture (titrating in the centrifuge tube); (3) Titration of the used oil in a glass beaker; the oil is previously desludged by centrifuging.

Data are given to show that acid compounds of oil sludge pass over into the alkaliblue mixture solution when titrating used oils. Further data derived from service tests in the engines of a diesel-electric paddle-wheel river tug are given to show that the properties of used oils are determined by service conditions of the engine at least as much as by minor differences in the qualities of the oils themselves. K. C. G. K.

442. Static Determination of the Yield Value of Plastic Systems by the Withdrawal Method. Its Application to Drilling Muds. R. Metrot. *Rev. Inst. Franç. Pétrole*, 1946, 1, 79.—The withdrawal method for the study of drilling muds, consists in suspending a thin metal plate vertically in the sample, by means of a wire attached to one beam of a balance; the balance is counterpoised with sand till the plate is withdrawn from the sample. The plate, which may be of any shape or size, provided that the ratio of thickness to area is small and that sharp corners or perforations are absent, is previously calibrated by immersion in a "true liquid," *i.e.*, one having no plasticity.

The yield value τ is given by the expression $\frac{mg}{2S}$ where m is the mass of sand required

to counterpoise the balance and S is the area of the plate; it is expressed in dynes/cm.² The application of this test to clay suspensions divides these latter into two groups, ABSTRAC

(a) non-thixotropic muds whose yield value is independent of standing time, and (b) thixotropic gels whose yield value varies with the standing time that has elapsed after agitation of the sample. Despite all the precations that can be taken the results given by this test are scattered and should be subjected to statistical analysis. The time t elapsing between the application of the load m and the withdrawal of the plate, varies exponentially with m; this measurement is only significant in the case of nonthixotropic muds, when t can vary from zero to infinity. An examination of the yield value as a function of the concentration shows that plasticity only appears beyond a certain minimum concentration λ denoted as the liquidity limit; below which solutions behave as true liquids and above which yield values make themselves evident and increase, till a critical concentration, P, is reached above which mixtures behave not as a suspension but as a porous medium which is saturated with water. On plotting the yield value against concentration on logarithmic co-ordinates there is obtained an S-shaped curve, which in addition to vertical asymptotes at values of the concentration corre-

sponding to λ and P also shows a break at a value of $C = \frac{\lambda + P}{2}$, for which the corre-

sponding yield value is denoted by a. The values of a, λ , and P are characteristic for the clay under examination, experimental figures are given for nine French clays which were investigated. The value of $P - \lambda$ is the plasticity index; it is of the order of 25 for non-thixotropic clay muds but falls to about 10 for thixotropic gels made from bentonites. The thixotropy of solutions of this latter is discussed and results showing the change of yield value on the ageing of solutions are given. It is concluded that the withdrawal method has the merit of simplicity and, whilst not adequate for determining all the rheological properties of clay suspensions and plastic systems, it can nevertheless give much information which is of immediate practical value. V. B.

443. Physical-Chemical Methods for the Analysis of Hydrocarbons and Hydrocarbon Mixtures. I. Infra-Red Spectrography and Its Applications. L. Robert. *Rev. Inst. Franç. Pétrole*, 1946, 1, 102.—A review. After an introductory definition of infra-red radiation and absorption, the principle of the infra-red spectrometer is explained and the characteristic features of the spectra of pure substances and of mixtures are briefly touched upon. The limit of accuracy of the method, when applied to petroleum problems, is discussed. V. B.

444. On the Application of Relative Light Dispersion to the Analysis of Hydrocarbon Mixtures. B. V. Joffe. Comptes Rend. (Doklady) Acad. Sci. URSS, 1946, 53, 433 (in English).—The relative dispersion ω is defined by the relation $\omega = n_1 - n_2 / n_3$, where n_1, n_2, n_3 are the refractive indices at three wave-lengths $\lambda_1, \lambda_2, \lambda_3$ such that $\lambda_1 < \lambda_3 < \lambda_2$, these being in the present case the H_F, Na_D, and H_C spectrum lines. Computations from literature data show that for paraffins and naphthenes ω has a mean value of 17.5 and is nearly double this value for monocyclic aromatics. For a mixture of saturates and an aromatic the relative dispersion is given by a simple additive function of the relative dispersions and weight fractions of the components. In the analytical application of this relation, the Abbe refractometer is used to measure both $n_{\rm D}$ and $n_{\rm F}$ - $n_{\rm O}$, the latter quantity being obtained directly from the reading of the refractometer compensator and corrected graphically for variations in $n_{\rm D}$, upon which it is dependent. For a single aromatic a set of linear graphs relating aromatic content and compensator reading can be constructed. Mixtures containing olefins also can be analysed by including an additional term involving the iodine value. Tests on about 100 synthetic mixtures each containing two or three hydrocarbons of the three types considered indicate that the aromatic content can be determined with an absolute accuracy of 1-2%. This can be improved by using the more precise Pulfrich refractometer. The method is claimed to be simpler, more rapid and more precise than that of Grosse and G. H. B. Wackher.

445. The Non-Adiabatic Functioning of Fractionating Columns. M. Simonetta and C. Capitani. *Chim. e Industria*, 28, 7–8, 115.—A method of assessment of laboratory columns is proposed which, taking account of the heat dispersed from the column, allows of a more precise calculation than usual of the number of theoretical plates. The results obtained in the assessment of a column 150-cm high are reported and agree fully with the theoretical calculation. D. H. McL.

Gas.

446. Super-Expansibility of Methane-Ethane Mixtures. W. O. Clinedinst. Refiner, 1946, 25, 296.—Methane-ethane mixtures expand more readily than is indicated by the ideal gas laws and this phenomenon is called super-expansibility. This deviation from the ideal has been approximated as the compressibility factor Z or its reciprocal expansibility Y which affects the flow of gas through pipe. This factor has been incorporated in a general flow equation based on the Weymouth formula. Two graphs of super-expansibility flow correction factors for methane-ethane mixtures are given.

G. R. N.

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447. Liquefied Petroleum Gas. G. G. Oberfell and R. W. Thomas. Refiner, 1946, 25, 158.—LPG comes from 3 sources, natural gasoline plants, refineries and cycling plants, the latter being a relatively recent source in which is utilized the physical phenomenon of retrograde condensation. Some of the most important markets in which LPG is used in large quantities are : motor gasoline blending, refining processes, synthetic rubber components, chemicals, carbon-black and plant fuel. The demand for these lighter hydrocarbons has even increased since the end of the war and it is expected that this demand will continue for several years to come. Less butane will be required for adjustment of gasoline vapour pressures, since increased cracking facilities have resulted in production of gasoline with original higher vapour pressures than formerly. However, since propane was substituted for butane in the blending of motor fuel, about 1.5 times the amount of LPG used in 1945 will be needed for this purpose. When blended with motor gasoline, butane is worth slightly more than motor fuel prices which are considerably above current LPG prices. If high octane number should become a competitive factor in the marketing of motor gasoline, it is possible that a number of alkylation plants using large quantities of isobutane and the C_3-C_5 olefins will be operated. Possibly between 2 and 4 million gal a day of butanes will be required for the post-war programme of synthesis of motor fuel and aviation components. The quantity of light hydrocarbons, especially propane, used for the production of chemicals is increasing steadily but still represents only 20-50% of the light hydrocarbons consumed by the LPG industry. The introduction of butane and propane in residue gas going to existing plants increased carbon-black production. Butane and propane cannot be extracted from residue gas beyond a certain point if a specified minimum carbon-black yield per cu. ft of residue gas burned has to be maintained. G. R. N.

Engine Fuels.

448. Relation of Octane Number and Peroxide Content of Gasolines. H. Velde (trans. by E. J. Barth). *Refiner*, 1946, 25, 285.—A record of storage data on straight run, vapour-phased cracked and mixed straight run-cracked gasolines with or without inhibitor, tetraethyl lead or alcohol addition. It shows that octane number falls as the peroxide number rises with the undoped gasolines and with most of the doped gasolines. Removal of the peroxides by acidic ferrous sulphate solution raises the octane number to somewhat short of the original value. Storage was carried out over 2 years in galvanized and iron drums.

449. Evaluation of Sulphur Compounds in Gasolines. F. C. Moriarty. Refiner, 1946, 25, 490.—Three groups of sulphur compounds may occur in gasolines: (1) acidic compounds such as H_2S and mercaptans, (2) neutral but thermally unstable substances as mono- and disulphides, (3) thermally stable compounds such as thiophenes. Group (1) can be determined directly and group (2) can be determined after catalytic desulphurization as H_2S ; any remaining sulphur can be classified as group (3). Lead susceptibility is affected by the first two groups so their removal is always desirable. Group (1) sulphur compounds can be removed by aqueous caustic, Girbotol or Shell T.P.P. processes and the Unisol process. Sweetening with doctor or coppet reagents oxidizes the mercaptans to disulphides and these are only recommended for very low mercaptan contents. With straight-run gasoline of relatively high mercaptan content catalytic desulphurization is preferable to extraction whereas the reverse holds for cracked gasoline. The Isoform catalytic process for treating cracked gasolines is

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competitive with the Unisol process. It effects little desulphurization, its principal advantage being isomerization. G. R. N.

450. Lead Tetraethyl as an Anti-Detonant. B. Ventura. Chim. e Industria, **28** (9-10), 149.—Having given a brief sketch of the first preparation of this important product (1854), the author describes two of the numerous industrial methods suggested and patented. He gives an exhaustive discussion of the manufacture of the product, describing the composition of the lead-sodium complex most convenient in practice, together with methods of analytical process control. The compositions of the various anti-knock blends are discussed and a table is given relating variation of density with temperature for one of the commoner blends for aviation engines. A description is given of the two most commonly used methods for the analysis of the commercial product or its blends with ethylene dibromide. Comments are made on the practical use of a quick electrolytic method which tends to give higher results than those obtained by ordinary methods. D. H. McL.

451. Comparison between Tetraethyl Lead and Nitrogenous Organic Anti-Detonants, and the Increase in Octane Number Attained by the Use of Both. Part II. G. Roberti, C. Minervini, E. Pipparelli, and E. Semmola. *Riv. ital. Petrol*, Oct. 1946, 162, 15.—A general article dealing with the stability of alkylate, with and without methyl aniline, the anti-knock characteristics of gasoline blends containing amines and tetraethyl lead, and aero and automobile engine testing of these types of fuels. D. H. McL.

452. Review of the Chemical Structure of Fuels and Their Detonation in Engine. A. G. Mazurkiewicz and V. G. Oberholzer. J. Inst. Petrol., 1946, 32, 685.—Due to the large accumulation of data published by the many laboratories working on the subject of combustion during the war, a need has arisen for a general review of the results. An attempt has been made here to bring out the salient features of the methods of investigation employed in this field. Some general suggestions have been put forward for the different classes of compounds considered in an effort to correlate chemical structure with engine performance of fuel and fuel additives. A. H. N.

Gas and Fuel Oils.

453. Cetane Number of Diesel Fuel. W. C. Friske. *Refiner*, 1946, **25**, 517.—A nomograph is set out relating the cetane number of a diesel fuel (straight run or cracked distillate) to A.P.I. gravity and boiling-point index (SKZ scale of Vorberg).

G. R. N.

454. Applying Combustion Knowledge. The Very Best in Oil Heating Depends on 101 Engineering Details. J. W. Schulz. Fueloil & Oil Heat, October 1946, 5, 58.—This paper completes the series on combustion testing complications (see Abstracts Nos. 135 and 136, 1947) and reviews and expands the data already given on the determining and reporting of efficiencies of boilers and furnaces as computed from charts and tables from stack and CO_2 readings. Care is needed in reporting the results under such terms as Over-all efficiency and Absorption efficiency as all charts and tables are not constructed on the same basis, moreover on-off periods of firing greatly affect the efficiency. The terms Over-all efficiency and Absorption efficiency are explained and illustrated by diagrams, and practical means are discussed by which such installations may be improved to effect greater efficiencies. W. H. C.

455. Horizontal Rotary Burner Service. Some Hints on the Maintenance of a Clean Heavy Oil Fire. K. Steiner. Fueloil & Oil Heat, Oct. 1946, 5, 52.—A sketch is given of the air nozzles and corresponding atomizers of fixed and adjustable horizontal rotary oil-burners which shows the nozzle bore, atomizer diameter and the clearance between the edges of both. A diagram shows a typical hook-up of the burner, its integral oil pump, piping and auxiliaries of the system. Regular observation of the burner flame and condition of the furnace will afford evidence of some of the imperfections in burning. These and other indications useful in detecting the cause or causes of defective burning or defects in the installation are discussed, and the methods for their

correction to obtain better burner performance are given. Two diagrams useful in this connection are shown. W. H. C.

456. Significance of Cetane Number in Fuels. E. F. Griep and C. S. Goddin. J. Soc. aut. Engrs, 1946, 54, 436.—Although Cetane No. is important as a measure of ignition quality, it is suggested that it is not the only criterion of a good diesel fuel. Properties concerned with the rate of flame propagation during the combustion stage are also important. However, high cetane fuels show no great advantage in engines of present-day design but it is indicated that engines specially designed could give high power output on these fuels. It is suggested that combustion research is needed to determine the optimum composition of fuels for high power output. Ignition promoters are discussed and results given for amyl nitrite blends with 50 Cetane No. fuel.

G. P. K.

Lubricants.

457. Physical Properties and Chemical Constitution of Lubricating Oils. M. Freund (trans. by E. J. Barth). *Refiner*, 1946, 25, 521.—Several lubricating oils of U.S., Rumanian, and Russian origin were analysed, and it was concluded that when well-refined lubricants are grouped together as to their similar viscosity at 50° C, then the specific gravity is a characteristic of the average chemical composition and for all such other physicochemical properties that are dependent on constitution. With an increase in the specific gravity, the average boiling-point, the mol. wt., the aniline point as well as the hydrogen content appears to decrease in regular fashion. In accordance with this it is found that the viscosity-temperature curve becomes more steep and the Conradson carbon value appears to decrease. With a further increase in aromatics and naphthenes the lower resistance towards sludge formation (evident throughout with increase in aromatics) finally becomes very pronounced. Certain of these properties can be affected by degree and type of refining, the presence of colouring matter or asphalts, etc.

458. Physical Chemistry of Lubricating Oils. A. Bondi. *Refiner*, 1946, 25, 337.— This, the second article of the series, discusses the dependence of viscosity on temperature, pressure, and concentration. The relationship between the temperature, pressure, and blending coefficients of viscosity and the chemical composition of lubricants is interpreted in terms of the Eyring theory of flow. A section is devoted to the anomalous flow of lubricating oils: at low temperatures or due to temperature gradients within the fast-flowing oil films, or due to the presence of high mol.-wt. additives which have now gained a place of prominence in many important applications. The final section deals with the application of present knowledge about lubricating oil behaviour under the influence of high-velocity gradients and high specific pressure to the calculation and lubrication of journal bearings. G. R. N.

459. Physical Chemistry of Lubricating Oils. A. Bondi. *Refiner*, 1946, 25, 387.—In this, the third and final of the series, the optical and electrical properties of lubricating oils are discussed under : measurement of colour, nature of colour substances, ultraviolet absorption, infra-red absorption, and Raman spectra, fluorescence, refractive index, and optical rotation, dielectric constant and dipole moment, dielectric loss, electrical conductivity and related phenomena, dielectric strength, electrochemistry and voltolization. 142 references for the complete series. G. R. N.

460. Recent Developments in Lubrication. S. J. M. Auld. Petrol. Times, 28.9.46, 50, 998.—The advantages of mineral oils over other substances for use as lubricants are discussed. Mineral lubricating oils do have certain disadvantages, however, chief of these being viscosity variation with temperature, and oxidation at high temperatures and pressures. Methods of improving lubricating oil properties fall into three classes : (1) improvements in refining technique, (2) use of additives, (3) synthesis, and also (4) combinations of these. Recent developments along these lines are briefly reviewed. R. B. S.

461. Detergent and Dispersive Properties of Engine Oils. J. Groff. Rev. Inst. Franç. Pétrole, 1946, 1, 3-15.—A review of the causes of oil deterioration and of the effect

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of this on engine operation. Dispersive power is considered to be more important than detergency. The introduction of HD oils into France gave rise to trouble due to the use of such oils in old and dirty engines. Results are given of stability tests (heating for 22 hr at various tenperatures) on SAE 30 and 50 oils, both of the HD type and on such oils after treatment with adsorbents to remove the additive. Taking as an indication of deterioration the rise in viscosity and in petroleum ether insolubles there was in each case a marked change at 275° C, indicating that the oils should be used at temperatures below this figure; the removal of the additive had no appreciable effect on the formation of insoluble matter but, in the case of the SAE 50 oil it caused a drop of 11% in viscosity. Engine tests (Citroen 11 hp operating on producer gas) using an initial charge of lubricant derived from shale oil and topped up during the test (50 hr) with HD 30 showed that the latter had two distinct effects, during the first period there was a detergent action, in the second period (after the 40th hr), when the proportion of HD oil in the crankcase was appreciable, the dispersing power was the more marked. These conclusions are supported by photomicrographs of the oil. A brief account is given of the engine and foaming tests used in testing oils to the U.S. 2-104B specification. V. B.

462. Oilspread and Lubrication (1). A. H. Stuart. *Petroleum*, 1946, **9** (12), 283.—The phenomenon of oil spread and conditions influencing it is discussed. In the case of "metal to metal" contact only a few points of very small area are actually on contact. Molecular attraction extends for only a few Angstrom units, whereas the irregularities on the best metal surface finish are usually of the order of 100 times this amount. Where the separation is small enough for molecular forces to operate, what may be regarded as "local welding" takes place. This is the basis of seizure.

The coefficient of friction of metals measured under ordinary laboratory conditions is nearly always less than one, but the surfaces tested are not those of the metals themselves, but of films which form on them (due to adsorbed gases, *e.g.*, oxygen, metallic oxides or moisture and dust). When de-gassed, pure clean metals are used, very high coefficients of fractions are obtained, often of the order of 5 or 6 and with gold, approaching 30.

The relative motion between two metal surfaces appears quite smooth but with suitable apparatus it can be shown to consist of a series of jerks (" slip-stick " motion) with unlubricated metals as well as in the presence of some lubricants. This is probably due to the formation and rupture of the welded bridges produced by intermolecular forces at certain points The object of lubrication is to secure a lubricant-film sufficiently thick to keep the bearing surfaces apart. At high loads and low speeds, as with gear wheels and cold pressing, the film cannot be maintained. These conditions may arise in abnormal circumstances in a bearing where full-film lubrication is normal, when a sudden rise in load or temperature reduces the viscosity below the safety margin. The thin film left may be only one of two molecules thick and the term "boundary conditions" has been applied to this state. The function of the oil is quite different from what it is with normal lubrication. If the temperature rises further, the boundary film will be unable to carry away the heat generated in the bearing and seizure will probably occur. The ability to leave a tenacious boundary film when the bulk of the oil has been squeezed out is termed "oiliness." Vegetable oils possess it in a higher degree than mineral ones, but a mixture of the two combines this advantage with the stability of mineral oils. Adding from 1 to 2% of fatty acid is usually satisfactory. For extremely high loads other additives may be necessary, e.g., sulphonated oils, chlorinated waxes, and lead soaps. K. C. G. K.

463. Principles of Filtration. 4. The Case of Colloidal Graphite. A. H. Stuart. *Petroleum*, Nov. 1946, 9 (11), 262.—Colloidal graphite as a lubricating oil additive has become of major importance during recent years, especially for running-in engines and under conditions of abnormal temperatures and loading. In the majority of filters the interstices are much larger than the particle size of colloidal graphite, but filters retaining the graphite and passing clear oil can be made, *e.g.*, an edge filter with paper discs packed under sufficient pressure. However, as graphite is very responsive to surface activity, filters of the adsorbent type also retain graphite contained in lubricating oils. In such cases the filtering septum adsorbs a certain maximum quantity of colloidal graphite but thereafter little further loss need be expected.

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Details are given of a test made to ascertain whether colloidal graphite, like amorphous carbon, will act as an emulgent to produce a water-in-oil emulsion. No such emulgent properties were found. Evidence is also given indicating that the passage of a graphited oil through a given filter is usually higher than the plain oil under the same conditions. K. C. G. K.

464. On the Main Types of Oil and Gas-Bearing Platform Structures. N. J. Uspenskaya. Comptes Rend. (Doklady) Acad. Sci. URSS, 1946, 53, 347 (in English).— Local uplifts which complicate the structure of large platform arches and basins are subdivided into three groups: (a) buried structures, (b) surface structures, (c) salt domes. Group (a) is discussed in detail and further subdivided into "revived" and "compacted" structures. The geological characters, oil and gas contents, and conditions for gas and oil occurrence of these two subdivisions are tabulated, together with actual examples. Group (b) surface structures are briefly defined. 6 references.

G. H. B.

465. On the Rolling of a Cylinder Over a Surface Covered with a Viscous Layer. N. A. Slezkin. Comptes Rend. (Doklady) Acad. Sci. URSS, 1946, 52, 573 (in English).— Starting from the well-known equations of Osborne Reynolds' theory of lubrication, expressions are derived connecting the tractive force, fluid film thickness, angular velocity of rolling and viscosity of the fluid for the system defined by the title of the paper and used to obtain the coefficient of rolling friction. Complete and approximate expressions are also given for the case where the cylinder executes pure sliding motion without rotation. G. H. B.

466. Steam Turbine Lubrication Problems and Their Solutions. 3(1) Cooling Function of the Oil. Alan Wolf. *Petroleum*, 1946, 9 (12), 277.—In a large modern turbogenerator set the heat to be extracted from the oil is of the order of 2 million B.Th.U. per hour, and the combined loss from fraction and heat transmitted to the bearings is estimated at about $1/3^{\circ}_{0}$ of the rated horse-power of the turbine.

Failure to extract heat from the oil sufficiently rapidly might result both in the weakening the mechanical strength of the bearing and in lowering the viscosity of the oil in the bearings to such an extent that the oil film could no longer support the rotor journals.

Because of moderate bearing pressure and high peripheral journal speeds oils with viscosities as low as 130-140 S.S.U. at 110° F and 40 sec at 210° F may be used in direct drive turbo-generators, but any substantial reduction in viscosity would be dangerous, due to frictional heat. The rate of oil circulation is also important. The capacity of the oil tank is now usually based on a circulation period of 5 min. There are a variety of designs for oil coolers. In the earlier types the tubes were usually of the U type but most modern equipment has straight tubes, which are easier to clean. This type usually resembles the parallel tube condensers met with in petroleum refineries (the tubes being horizontal). In another type the oil is pumped in succession through two adjacent vertical cylinders and cooled by water flowing counter-current. This design is sometimes found to tolerate remarkably large amounts of sludge with no apparent falling off in efficiency. K. C. G. K.

467. Industrial Emulsions. E. H. Kadmer (trans. by E. J. Barth). Refiner, 1946, 25, 351.—A series of emulsions are described for use in metal cutting, grinding, boring, etc. New emulsifiers and methods of preparation are given. In one series of tests it was shown that when making mineral oil emulsions it appears that greater amounts of emulsifier are consistently needed as the viscosity of the mineral oil increases. In a second series of tests it is shown that certain "inherent polar bodies" present in commercial and especially in unrefined oils greatly aid in obtaining good emulsions. It appears that with such oils the emulsifier functions more efficiently. No stable emulsions are possible (after several weeks' standing) with highly refined oils using the normal amount of emulsifier. The quantity of emulsifiers used are already quite high. In a third series of tests the relation is shown between stability and type of dispersions when the system graphite plus oil is emulsified. Several methods of preparing graphite emulsions are given. G. R. N.

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468. Manufacture and Use of Lubricating Emulsions. L. Boisselet. Rev. Inst. Franc. Pétrole, 1946, 1, 97.-The lubrication of railway locomotives by water-in-oil emulsions was a successful economy measure adopted in France during the war. The water content of such emulsions can be as high as 50%, whilst the amount of emulsion used for lubricating does not exceed the normal consumption of straight mineral oil, thus showing a considerable saving of the latter. Emulsions can be prepared by using thinner oils than the cylinder oils normally used for steam engine lubrication, despite the high water content the pour-point can be as low as -20° C; the emulsions are stable in storage. They exhibit thixotropic properties. A variety of emulsifying agents can be used; unless, however, a calcium soap is employed for this purpose, the water used for preparing the emulsion should be fairly soft. Emulsification can be produced either mechanically or by the use of steam. Three main types of emulsion were prepared : (a) lime water, fatty oil, mineral oil, fatty acid, (b) water, blown fatty oil, wool wax, mineral oil, (c) steam, blown fatty oil, wool wax, mineral oil. The procedure for preparing emulsions of these types is described. It is suggested that if superheat temperatures were to be raised above those now in common use, emulsions such as these would be the only lubricants that would resist decomposition. It is urged that the use of such lubricating emulsions should increase, in order to economize the consumption of scarce high-grade mineral oils. An editorial note suggests that emulsions could be employed in the lubrication of refrigeration compressors.

V: B.

469. Hub-Wedge and Curve Greases. A. E. Hickel. *Refiner*, 1946, 25, 518.—Manufacturing methods and testing for these greases which are used in railroad equipment are discussed. The Hub-Wedge grease is a straight lime-base grease without fillers or additives. The Curve grease is also a lime-base grease containing a specific amount of micronized graphite. The pour-point of the oils used in the Curve grease ranged from -65° F to -20° F with low viscosity necessitating a small amount of E.P. additive. G. R. N.

470. The Hypoid Gear. P. H. Moore. *Petroleum*, 1946, **9** (12), 282.—The development of the hypoid gear is traced and the extent to which it is used in the American motorcar industry is indicated. Before the war very few British cars used this gear, but its use will probably spread, creating a demand for hypoid gear oil. K. C. G. K.

Bitumen, Asphalt and Tar.

471. A Mobile Hot Asphalt Plant. Anon. Engineer, 1946, 182, 562.—A number of interesting features are incorporated in a mobile hot mix tarmacadam and asphalt plant, capacity 20 tons per hr. The plant consists of 3 main units, viz., feeding, drying, and mixing, each mounted on pneumatically tyred wheels. The units are jacked off the ground when in use, and the wheels stored. The feeding unit handles two grades of aggregate by belt conveyor to a rotary dryer 18 ft long by 4 ft diameter, heat being supplied by two high pressure oil-burners mounted in a dual combustion box at the discharge end of the dryer. A fan at the other end of the dryer extracts hot gases. A gear pump mounted on the dryer framework draws bitumen from independent boilers which are arranged singly or in groups, as required, at the side of the plant. The dried aggregate is elevated to a 12 ft by 3 ft Oscillex screen, and weighed into a 1 ton paddle mixer with cement filler and bitumen from a weighed tilting bucket. Control doors from the various compartments are pneumatically operated from a central control cabin. The plant is driven by a 60 h.-p. oil engine.

Special Hydrocarbon Products.

472. Aromatic Hydrocarbons from Petroleum. The Catarole Process. Anon. Petroleum, 1946, **9** (11), 252.—A brief review of some of the main points of the Catarole process for the simultaneous production from an essentially non-aromatic charging stock (such as naphtha or gas-oil) of the whole range of aromatic hydrocarbons in substantially pure form. In addition, a valuable gas mixture containing a high proportion of olefines is produced. K. C. G. K. 473. Field Experiments with Heat-Generated Aerosols. R. Latta. Economic Entomology, Oct. 1946, 39, 614.—Results of study of the behaviour of aerosol clouds when applied to forested areas in New England, 1944-45 are given.

The larvæ of the gypsy moth, *Porthetria dispar* (L.) was used as subject for control. Two thermal generators were used, an army oil-fog generator and a Hochberg-La Mer aerosol generator.

The aerosols were generated by adding D.D.T. dissolved in cyclohexanone to the oil supply of the generator.

Successful applications depended on a steady wind of 10 m.p.h. or more above the forest canopy, or one good inversion with an evening air drainage down a mountain slope.

Complete mortality of the larva was obtained at a depth of 800 ft with 0.138 oz D.D.T. per front ft.

The Hochberg-La Mer generator produced a deposit possessing repellent properties.

G. A. C.

474. Modified Aerosol Formula for Use Against Mosquitoes and Houseflies. A. H. Madden, H. O. Schroeder, E. F. Knipling, and A. W. Lindquist. *Economic Entomology*, Oct. 1946, **39**, 620.—The basic D.D.T. aerosol formula (5%) D.D.T. plus 10% of cyclohexanone) for use against malaria mosquitoes and houseflies was modified by addition of fatty materials or of wetting agents. Fatty materials used included propylene glycol monoleate, propylene glycol monolaurate and oleic acid; and wetting agents used were *Vateol OT* (dioctyl sodium sulphosuccinate) and *Nopco* 1216 (sulphonated sperm oil).

There was no material increase in the effectiveness of the basic formula.

Motor oil was found to be as effective as sesame oil in the pyrethrum aerosol (0.4%) of pyrethrins) containing 8% of oil, and it also increased the effectiveness of the D.D.T. formula. Results were independent of the viscosity of oil used.

A formula containing 3% D.D.T., 5% cyclohexanone, 5% motor oil, and 0.3% pyrethrins was developed. This is relatively stable at low temperatures, safe to use in presence of plastics, and is equally effective against both mosquitoes and houseflies. G. A. C.

475. Plastics from Petroleum. 4. Statistics. W. S. Penn. Petroleum, 1946, 9 (11), 266.—Tables of production figures for past and present years (including those for synthetic rubber), both in the United Kingdom and the United States are given and discussed. K. C. G. K.

476. Molecular Weights in Practice and Theory. I. Practice, 2(1) Physical Methods. A. V. Brancker. *Petroleum*, 1946, 9 (11), 250.—The following methods are discussed : those of Dumas and Victor Meyer, and the cryoscopic (Beckman) method, with various modifications as regards stirring and temperatures measurement. K. C. G. K.

Derived Chemical Products.

477. Petroleum. Raw Material for Organic Synthesis. G. E. Villar. Bol. del Inst. Sudamericano del Petroleo, 1946, 2, 355.—A general survey of progress in chemical synthesis from natural and cracked gases during the last 10 years, together with production statistics of the various derivatives. The article is profusely illustrated with photographs of American plants, and a bibliography of 20 references is included. A. C.

478. Basic Oxygenated Chemicals from C_1 , C_2 , and C_3 Parafins and Olefins. J. and C. Walker and H. L. Malakoff. Oil Gas J., 21.12.46, 45 (33), 59.—The four principal approaches in the production of oxygenated hydrocarbons from natural gas or refinery gases are: (1) direct oxidation, (2) dehydrogenation followed by oxidation or hydration, (3) oxidation to CO and hydrogen and hydrogenation of the CO, (4) chlorination followed by hydrolysis. Production and market data with respect to oxygenated products are given and their production from natural gas and or refinery gases, and other sources is shown in diagrams. The City Services Oil Co., at Tallant, Okla., installed

ABSTRACTOR

the first commercial plant in 1936, employing direct oxidation and have since expanded commercial production and recently added 3 new plants. They were the first to use ion exchange in this field and in this way met the rigid specifications for low acidity formaldehyde set by the resin and plastics industry. The activities of other U.S. concerns in these fields are discussed and the names of the firms, location, and types of plants and products made are given. Future oxidation processes covering the Fischer-Tropsch and related processes are outlined and discussed, and processes for making actylene and its oxidation derivatives, by silent electric discharge and high-temperature cracking of hydrocarbon gases, now in pilot plant stages, are outlined. Reference is made to the Shell Co's likelihood of manufacturing glycerine from propylene, and the U.S. Technical Missions work on the production of ethylene from ethane, by its partial oxidation, as employed at Leuna during the war. W. H. C.

Coal, Shale and Peat.

479. Swedish Method of Manufacturing Liquid Fuel from Low-Grade Shales. S. V. Bergh. Oil Gas J., 28.12.46, **45** (34), 250.—One of the methods now used in Sweden to produce oil from naturally occurring low-grade shale, involving low-temperature distillation is described.

The plant consists of retorting and condensing units with auxiliary power and sulphur plants. Retorting of the crushed shale is carried out in a large number of small heat-controlled retorts; hot cake residue from the distillation is burnt as fuel.

The sulphur plant separates H_2S from the distilling gases and produces elemental sulphur from the H_2S .

56,500 brl of crude oil is produced from 213,839 tons of shale per year, and 3200 tons of sulphur is recovered. Cost of extraction is slightly above pre-war oil import prices. Tables show costs, properties of products produced and monthly production.

G. A. C.

480. Substitute Fuels in Australia. J. Fielder. Gas Oil Pwr, 1946, **41**, 460.—In the absence of petroleum deposits in Australia, experiments have been made on substitute fuels for motor vehicles. Charcoal, used as a source of producer gas, was sold in briquette form, some 400,000 tons being consumed annually. The cost of conversion was about £50.

Methane obtained from a disused coal-mine could be used without purification. The heat content was 970 B.Th.U. and the total impurities 3%. Working pressure was 1800 p.s.i., and the cost of conversion was \$95.

Town gas of average calorific value 550 B.Th.U. was used at a pressure of 3000 lb. H. C. E.

Miscellaneous Products.

481. Caustic Solutions. W. L. Nelson. Oil Gas J., 7.12.46, **45** (31), 119.—No. 122 in the Refiner's Notebook series tabulates the specific gravity and weight % of NaOH of caustic soda solutions for temperatures from 60° F to 212° F and percentages of NaOH from 0 to 50%. G. A. C.

482. New Synthetic Organic Insecticide : Hexachlorocyclohexane. M. Raucourt and R. L. Bouchet. *Chim. et Ind.*, 1946, 56, 449.—The insecticidal value of hexachlorocyclohexane (H.C.H.) was first observed in France in 1940-41. The chemistry and industrial manufacture of H.C.H. is briefly discussed, as well as the relative toxicity of the various isomers. A list (not claimed to be complete) of various agriculturally undesirable insects that are susceptible to H.C.H. is given. A bibliography of 26 references (mainly to French work) is appended. V. B.

483. The Gelation of Petrol for Use as a Flame-Thrower Fuel. J. N. Gregory. Jour. Council for Sci. and Ind. Res. (Australia), 1946, 2 (19), 153.—A description is given of the work carried out in Australia in the development of a gelling agent for petrol for flame-thrower fuels.

The Australian army required that the gel should be capable of being rapidly prepared in the field from ordinary transport petrol, so that the British method requiring special warming equipment for the petrol was not suitable, while the material used by the U.S. was not available in sufficient quantity.

An aluminium oleate containing 10% Al₂O₃ was found to give the best all round gelling and handling properties and when this material was stirred with petrol in about 5% concentration it rapidly swelled. In a few minutes a gel was formed which became homogeneous in a few hours. The aluminium oleate of certain closely defined chemical and physical properties was prepared by precipitation from an alkaline sodium oleate solution with alum at $60-80^{\circ}$ C, can be represented by the formula Al(OH)₁₋₃(C₁₇H₃₃COO)₁₋₇ and is believed to be a mixture of the mono-hydroxy dioleate and the di-hydroxy mono-oleate. The addition of $2\%\beta$ -naphthol (added in the caustic soda) eliminated possible oxidation and facilitated rapid drying.

The effect of various conditions affecting stability of the gel are discussed. The compound, under the name of "Geletrol," was developed to full-scale production and was considered to be one of the most effective methods of overcoming Japanese bunker defences. T. M. B. M.

ENGINES AND AUTOMOTIVE EQUIPMENT.

484. New American Light Engine. Anon. Aeroplane, 1947, 72, 16.—Some information is given on a light inverted 4-cylinder air-cooled engine produced by the Cameron Engine Corporation (U.S.).

Leading particulars are as follows: Dimensions: Length 45-1 in; Width between engine mounts, 13¹/₄ in. Weights: A little more than 1¹/₂ lb/h.p. Performance: Max. power 125 h.p. at 2500 r.p.m., or cruising power 110 h.p. at 2200 r.p.m.

I. G. B.

485. Cold Starting. Anon. *Flight*, 1947, **51**, 41.—Data on cold starting have been collected by a committee of the S.A.E. Aeronautics Division.

For satisfactory starting at sub-zero temperatures the following requirements must be met: (1) the engine must be turned over at an adequate speed, (2) sufficient power must be available for two 30-sec cranking periods, (3) a combustible mixture must be delivered to the cylinders, (4) an adequate spark must be produced, (5) the engine must receive a usable lubricant, (6) fits and clearances of mating surfaces must be such that normal functions occur irrespective of the temperature. I. G. B.

486. Soviet Aircraft Engines. Anon. *Flight*, 1947, **51**, 86.—Details of representative operational types are given under the headings: type; no. and disposition of cylinders; cooling; bore; stroke; capacity; compression ratio; output; r.p.m.; boost; fuel consumption at take-off, nominal and service ratings; octane number of fuel; weight; width; height; length; aircraft fitted. I. G. B.

487. Water Injection in a Spark-Injection Engine. W. P. Green and C. A. Shreeve. Trans. Amer. Soc. Mech. Engrs, 1946, 68, 541.—The recent war witnessed a revival in the use of water as a coolant and detonation suppressor inside the engine cylinder. Aircraft engines when operated with water injection have been boosted in output above normal sea-level capacity and have functioned satisfactorily. This paper gives a review of past tests on the use of water as a coolant and detonation suppressor in gasoline engines. It presents new data regarding the use of water in very high-compression ratio engines to promote increased part-load efficiencies with low octane fuels.— (Author's abstract.)

488. Diesels and the Oil Industry. A. W. McKinney. *Petrol. Times*, 28.9.46, 50, 1012.—Diesel engines are rapidly replacing gas engines and steam boilers in oilfield operations owing to the increasing value of natural gas in repressuring projects and as a raw material. The 5 general applications of diesel engines in the oil industry are: (1) drilling operations, (2) pumping and repressuring wells, (3) pipeline operations, (4) refining operations, and (5) exploration and transportation vessels and vehicles. These are briefly discussed. R. B. S.

489. Low Temperature Starting. Anon. Gas Oil Pwr, 1946, **41**, 463.—Research was carried out on the best means of starting I.C. engines at low temperatures : 0° F for use on the Continent and -40° F for use in Russia. Since with many fuel oils the necessary reduction of pour-point temperature also reduced the cetane number, the fuel specification had to be carefully laid down. The grade of lubricating oil was SAE 20W.

To determine whether engines would run satisfactorily on the fuel specified, singlecylinder engine tests were made. They showed that the effect of cetane number on ignition delay could be neglected. Gumming, severe at 75° F jacket temperature, disappeared at 115° F. The fuel could not be satisfactorily handled by the injection pump until the pressure of the feed system was raised to 15 p.s.i. and the felt filter elements replaced by 140-mesh gauze. As an aid to starting the induction air was heated by a small pressure oil-burner in the intake pipe, as near to the cylinders as possible.

It was found that ease of starting was increased by retarding the injection by 7°, but the start was indefinite. Increased quantities of fuel at starting was also beneficial. Promoters, such as amyl nitrite, ethyl nitrate, and ether, were used successfully, but no single method was completely satisfactory. A starting system incorporating all the methods mentioned, together with a device for allowing the starter to remain engaged after firing had commenced, was finally adopted. H. C. E.

490. Measurement of Smoke in Diesel Engine Exhausts. C. J. Goode. Gas Oil Pur, 1946, **41**, 469.—When in a C.I. engine the fuel is not completely burnt the combustion efficiency falls off and carbon particles appear in the exhaust gases. Since these two properties are intimately related, combustion efficiency can be rated by the appearance of the exhaust gases. Visual observation of the smoke is imprecise, and the method of staining a white fabric, although more accurate, becomes very tedious when the amount of carbon is assessed.

A photo-electric cell can be used to measure the smoke density of the exhaust gases. The apparatus consists of a photo-electric cell and lamp situated at opposite ends of a tube through which either exhaust gases can be blown, or pure air drawn. The power of the lamp is adjusted until a constant intensity of light reaches the photocell with pure air in the tube, and the decrease in intensity when smoke passes through the instrument gives the smoke density according to the equation :

Smoke density per unit length of smoke column $= rac{100}{s} \log rac{L_0}{L}$

Where L_0 and L are intensities of illumination through air and smoke respectively, and s is the effective length of the smoke column.

In using the apparatus precautions to be taken include : Removal from the exhaust gases of moisture which would otherwise condense on the glass surfaces; attainment of atmospheric pressure in the tube; and fitting the sampling outlet at a point in the exhaust which gives a representative sample of gas from all cylinders. H. C. E.

491. New 2000-H.P. Gas-Turbine Generator Burns Bunker C Fuel Oil. T. I. Putz. Oil Gas J., 4.1.47, **45** (35), 27. (Paper presented at Annual Meeting of the Amer. Soc. mech. Engr., New York.)—A brief description is given of the 2000-h.p. Gas-Turbine generator and its operation. The design is a simple type open-cycle system comprising only a compressor, combustion chamber and turbine which is connected through a single reduction gear to a double-armature d.c. traction type generator. The turbine generates approximately 6000 h.p. of which 4000 h.p. is required by the compressor and the balance of power is used for generating electricity. At full load the turbine and compressor speed is 9200 r.p.m. and the generator is run at 1200 r.p.m. The system is useful for a portable power plant for field work, or as a power unit for gas transmission lines, and as its total weight is only 38000 lb it is particularly attractive for driving an electric locomotive. Burning No. 6 (Bunker C) fuel oil to compensate economically for an expected thermal efficiency of its simple open cycle of 20%, at full load, the gas-turbine generator set operates at a top temperature of 135° F. W. H. C.

492. Resistance Welding in Engineering Construction. S. H. Gordon. Trans. Inst. mar. Engrs, 1947, 58, 225.—The applications of resistance welding have increased enormously since the first patent was taken out in 1853. In all the modern variations

of the process, spot welding, seam welding, projection welding, flash welding, and the modifications thereof for special purposes, single-phase alternating current has been found to be the most suitable form of electrical energy, as the ranges of voltage required for the different heating conditions in resistance welding can be most conveniently covered with this current.

Special machines are constructed for the various types of resistance-welding processes and also for specific types of operations, such as rail welding and air-screw hub welding. Crankshafts can be flash-butt welded and it has been shown by various tests that the repaired crankshafts are satisfactory in service. O. M.

MISCELLANEOUS.

493. Oil Costs in the United States. Anon. Petrol. Press Service, 1947, 13 (11), 201.— Facts about increased costs in finding and producing oil in U.S. have not always been fully understood. This article gives an overall picture of the present situation and deals with the history of oil costs from the earliest stages. In the main it is stated that rising costs are due both to the decreasing rate of finding new oil deposits and to the increasing expense of exploration. G. P. K.

494. Organization and Operation of Refining Division of Petroleos Mexicanos. C. Corcijera. Oil Gas J., 28.12.46, 45 (34), 228.—The Mexican government set up an organization to manage the entire industry, production and refining activities being divided.

The refining division controls all operations and covers all refining, administrative and technical functions, operating in 3 zones, northern, central, and southern.

A repair and enlargement programme was instituted after study of all the existing plant, and as a result output was increased and range of products extended.

The uneconomic topping unit at Bella Vista was closed.

A programme has been worked out based on estimated demand in Mexico up to 1950, and further plants and pipelines are projected. Tables show demand for products 1946-50, composition and production in mol. lb per hr of natural gasoline and crude from the Poza Rica, and estimated production from the topping, Dubbs cracking, butane isomerization, and H.F. units added to the Atzcapotyalco plant.

G. A. C.

495. Official Petroleum Statistics of Bolivia. Anon. Bol. del Inst. Sudamericano del Petroleo, 1946, 2, 481.—Production in the first half of 1946 was up to 186,000 brl, as against 162,000 brl for the corresponding period of 1945. A. C.

496. Official Petroleum Statistics of Brazil. Anon. Bol. del Inst. Sudamericano del Petroleo, 1946, 2, 471.—Production in 1945 is given as nearly 80 million brl, about 25% increase over the previous best. Some photographs of recent drilling operations are included. A. C.

497. Official Petroleum Statistics of Colombia. Anon. Bol. del Inst. Sudamericano del Petroleo, 1946, 2, 413.—Production figures show a steady increase from 1933 to 1940, then a sharp drop in 1942–43 and a recovery in 1944–45. Average production is of the order of 20 million brl p.a. or about 1% of world production. Cumulative production to the end of 1945 was over 370 million brl. A. C.

498. Research Laboratories of the U.S. Refining Industry. (Organization and Equipment.) M. T. Reis. Bull. Assoc. Franç. Tech. Pét., 1946, (60), 3.—Following a brief general discussion on scientific research in the U.S. the planning of petroleum research (government, academic, and industrial) is described and the functions of bodies such as the A.P.I. and A.S.T.M. is outlined. A short illustrated account is given of the organization and layout of some typical industrial laboratories and pilot plant installations. In the equipment section of the paper a few paragraphs are devoted to each of the more important types of recent physical instruments (e.g., mass spectrograph, electron microscope) with an indication of the uses to which such equip

ment can be put in petroleum research and of the accuracy of results that it may be expected to yield.

499. National Fuel in France. Anon. Petroleum, 1946, 9 (12), 280.—A short article on the use of France's resources in lignite, shale, and peat for the production of oil. K. C. G. K.

500. French Motor Fuel Problem. E. G. Voiret. Chim. et Ind., 1946, 56, 423.— A discussion as to the most suitable means of providing, under present conditions, fuel for motor vehicles and agricultural tractors. Synthetic fuels are too costly and the plant is excessively vulnerable; moreover, French coal supplies are inadequate for this purpose. Solid fuel used in producer gas plants is the cheapest for road vehicles and agricultural tractors; the latter could be operated on wood fuel and on farm residues. A plea is made for the better utilization of French lignite deposits, which by gasification would yield 6–8% of liquid fuel as well as combustible gas and valuable by-products. Some of the gas could be utilized for the production of methyl alcohol (by the reduction of CO); this latter fuel is the only synthetic worth considering from the economic aspect and then only as a blending agent. Other possible indigenous fuel sources are the hydrogenation of natural asphalts (obtained by solvent extraction) and the use of shale oils. French shales are poor in oil content but, it is argued, can be profitably utilized by modern recovery methods. V. B.

501. Italian Oil Industry Soon to Resume on a Expanded Scale. A. Giordano. Oil Gas J., 28.12.46, 45 (34), 210.—A review of the Italian oil industry is given.

Plans have been made to resume refining operations at certain plants and expand capacity at others. 800,000 brl of crude oil from Saudi Arabia are on route to Naples for the two refineries there. Dubbs thermal-cracking units at Venice are to be placed in operation.

The political situation in Italy explains delay in resumption of market activities.

The possibilities of erecting a Fischer-Tropsch plant at San Giovanni Valdarno is being discussed.

The future of the Italian oil industry depends on the supply of crude oil imports of which those on behalf of U.N.R.R.A. are to be exempted from duty.

A trade agreement with Hungary provides for the exchange of Italian tools and vehicles, etc., for 60,000 tons of Hungarian petroleum products. G. A. C.

502. Fog Dispersal. A. C. Hartley. J. Roy. Soc. Arts, 1946, 44 (4732), 22.—A description is given of the start and development of Operation "Fido" (Fog Investigation Dispersal Operations), and the contributions of the principal investigators and firms towards its successful application. The modifications and improvements of the vaporisers and burners, their testing and practical trials are described and shown in 8 photographs and diagrams. Some details are given of the diameters and lengths and of the piping, size of burner holes, and the spacing and disposition relative to the runways, operating, consumption of petrol in gallons per sq yd per hr, effectiveness in fog dispersal, cost of operating and satisfactoriness for aircraft landings. Petrol consumption ranged from 20 to 55 gal per sq ft per hr. The discussions on the paper are recorded. W. H. C.

503. Viscometric Investigation of Dimethylsiloxane Polymers. A. J. Barry. J. appl. Phys., 1946, 17, 1020.—The intrinsic viscosities of an extended series of linear methyl polysiloxane fluids, having dimethylsiloxane (Me_xSiO) as the repeating unit, have been determined in toluene solution. These values have been correlated with their mol. wt., determined chemically and by osmotic pressure and light scattering measurements. The Standinger equation was found applicable only for fluids of relatively low mol. wt., *i.e.*, up to about 2500; for the higher polymers, the best correlation of intrinsic viscosity with number average mol. wt. was found to be: $[\eta] = 2 \times 10^{-4} \text{ Mn}^{0.66}$. This held reasonably well for mol. wts. from 2500 to about 200,000. The bulk viscosities of the polysiloxane fluids were found to conform to the Flory relationship for melt viscositie; the expression : log visc.(cs at 25° C) = $1.00 + 0.0123Mn_{\frac{1}{2}}$ appears to be reasonably valid for mol. wts. above 2500.

APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

The following have applied for admission or transfer to the Institute. In accordance with the By-laws, the proposals will not be considered until the lapse of at least one month after the publication of this *Journal*, during which time any Fellow, Member, or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of the candidate.

The object of this information is to assist the Council in grading the candidate according to the class of membership.

The names of candidates' proposers and seconders are given in parenthesis.

Applications for Membership.

BALDRY, Ronald James, Trainee, The Petroleum Board. (R. J. Bressey; J. S. Wilding.)

DAVIES, Cyril Brynmor, Technical Editor, Aero Engine Laboratory, Thornton Research Centre. (C. G. Williams; F. L. Garton.)

DEACON, John Hereward, Trainee Sales Technical Adviser, Shell Petroleum Co. (G. D. Thacker; R. I. Lewis.)

FLOYD, Gerald Peel, Company Representative, Anglo-Dutch Petroleum Co. (R. E. E. Hadlow; J. H. Maltby.)

- GRIFFITHS, Rhys Gwilym, S/Leader, Technical Branch, R.A.F. (J. Mason; L. Bevan.)
- HAM, Albert John, Chemist-in-Charge, Shell Lubricating Oil Laboratory. (J. A. Oriel; R. I. Lewis.)
- HELLEWELL, David (Jr.), Manager, John Hellewell & Co. (T. G. Provest; T. J. Metcalf.)
- HUNT, Thomas William, Research Engineer, British Insulated Callender's . Cables, Ltd. (J. C. Quayle; C. H. Johnson.)

KIRBY, Alec William Wheatley, Manager, "Shell" Refining & Marketing Co., Ltd., Ardrossan. (R. I. Lewis; J. A. Oriel.)

- LENAERTS, Joseph, Chemist, A. A. Depauw & Co., Antwerp. (H. E. Charlton; F. Kind.)
- LOWENSTEIN-LOM, Walter, Chemical Engineer, Stalinovy Zarody, Czechoslovakia. (L. Ivanovsky.)
- MCNICOL, John Charles, Senior Research Chemist, Motor Industry Research Assoc'n. (C. G. Williams; E. A. Evans.)
- MARGETTS, Donald Roy Malcolm, Chemist, B. & R. Redwood. (W. L. Jelffs; A. T. White.)
- MASON, Donald Raymond, Technical Assistant, Anglo-Iranian Oil Company. (W. H. Thomas; W. A. Partridge.)
- COHEN, Nathan, Analytical Chemist, "Shell" Refining & Marketing Co., Ltd. (H. E. F. Pracy; D. H. Japes.)

Candidates for Admission as Students.

Proposed by F. H. Garner.

Collenette, Peter, Student, Birmingham University. (Geology.)

SHEASBY, Gerald Roy, Student, Birmingham University. (Chem. Engineering.)

Proposed by V. C. Illing.

- ROBINSON, Frederick David, Student, Royal School of Mines. (Oil Technology.)
- ROBINSON, Michael Priaulx, Student, Royal School of Mines. (Oil Technology.)
- SIMPSON, George Joseph Howden, Student, Royal School of Mines. (Oil Technology.)

INSTITUTE NO

Transfers.

- COOPER, Arundel David, Technical Adviser, Shell Petroleum Co. (R. I. Lewis; J. S. Jackson.) (Associate Member to Member.)
- KING, Henry Ernest, Deputy Chief Distribution Engineer, Anglo-Iranian Oil Co., Ltd., Iran. (C. T. Barber; G. W. Lepper.) (Associate Member to Fellow.)
- Ross, Kenneth Brebner, Works Manager, Anglo-Iranian Oil Co., Ltd., Abadan Refinery. (M. A. L. Banks; C. E. Spearing.) (Associate Member to Fellow.)
- TIRATSOO, Eric Neshan, Research Geologist, Royal School of Mines. (V. C. Illing; S. E. Coomber.) (Associate Member to Member.)



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Leonard Refineries, Inc. HOUDRY PROCESS CORPORATION Lion Oil Company Magnolia Petroleum Company

Richfield Oil Corporation Sinclair Refining Company Socony-Vacuum Oii Company, Inc. Standard Oil Company of California Standará Oil Company (Ofio) Tide Water Associated Oil Company Sun Oil Compuny Union Oil Company of California

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THE ILLUSTRATIONS SHOW :--

TOP. A view of the B. & W. Type "E" Mills in the basement.

RIGHT.—A view in the firing aisle showing the burner controls and some of the automatic electrically operated soot blowers with the A^T the North Tees "B" Power Station of the North-Eastern Electric Supply Company Ltd., there were recently installed two B. & VV. High Head Boilers each for an evaporation of 180,000 lb. per hour at 475 lb. per sq. inch and 725° F.

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soot blower control panel.

LEFT.—A side sectional elevation through the boiler.

BOTTOM.—One of the boiler control panels.

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