



# Integrated recycling technology as a candidate for best available techniques

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## ABSTRACT

**Purpose:** In this article the integrated recycling technology and the integrated recycling technology model as a future candidate for best available techniques (BAT) are presented.

**Design/methodology/approach:** The paper shows one of the procedures for selection a determinant of emission standards – BAT, which are a basis of BAT reference documents (BREFs).

**Findings:** The works relating to the emission standards stating according to best available techniques should have more and more meaning for all Member States and for Poland also. One of these activities is search of the best integrated recycling technology which allows to neutralize the definite part of waste in the most effective and simplest way.

**Research limitations/implications:** To protect the environment it is necessary a continuous adjusting to BAT requirements. It is always possible to find the better, effective or cheaper methods of the environment protection (e.g. the integrated recycling technology model proposed).

**Practical implications:** The implementation of the IPPC Directive requirements makes possible the technological processes realization with full protect of the environment. It refers to the recycling technologies too. Therefore, it is necessary to find the best integrated recycling technology which guarantees total waste reduction.

**Originality/value:** In this paper paid attention to the problem of the integrated recycling technologies. The proposed integrated recycling technology model is not only ecologically and technically practicable but also generates small costs.

**Keywords:** Industrial management and organisation; Environmental management; Best Available Techniques (BAT); Integrated recycling technology; Integrated recycling technology model

## MATERIALS MANUFACTURING AND PROCESSING

### 1. Introduction

One of the important steps in direction to the environment protection, especially in prevention of industries negative influences, is accepted in 1996 by European Council 96/61/EC Directive, colloquially named IPPC (Integrated Pollution Prevention and Control) [1]. It imposes a requirement for industrial and agricultural activities with a high pollution potential to have a permit which can only be issued if certain environmental conditions are met [2, 3]. The Directive fully considers the

principles, so it does not set standards or thresholds for the prevention or emissions control, or for other environmental aspects, but leaves this responsibility to the Member States. They must ensure that the particular industrial processes fulfilled emission limit values based on Best Available Techniques (BAT) [4].

The application of BAT shall be based on BAT Reference Documents (BREFs) developed by the European Commission.

One of the candidate for BAT can be the proposed integrated recycling technology model. This method still requires many investigation, but in the future it can be the pattern with minimum environmental impact and acceptable cost.

## 2. Integrated permission in Poland

Another meaning of the IPPC is the integrated permission. Poland introduced it in The Act on Environment Protection Law in 2001 [3].

Integrated permission is the action in which the conditions of activities performance in installations are determined and new installations are permitted with the purpose of achieving the integrated protection of the environment and its elements as well as to keep the pollution level in the quality norms [2]. It is an administrative decision which is a detailed licence on installation realization. It regulates all aspects of installation impact on the environment, too.

According to the IPPC Directive enterprises, the activities of which cause changes in the environment, will have to obtain one integrated permission [4-6]. It concerns enterprises in all Union Member States including Poland after its accession to the European Union. The Directive requirements refer to 6 general categories of industrial activities: energy, metals, minerals, chemicals, waste and others [1-3].

The permits do not prescribe the use of any techniques or specific technologies, and they can take into account the technical characteristics of the installation, its geographical location and the local environmental conditions.

## 3. Best Available Techniques (BAT) and BAT Reference Documents (BREFs)

The concept of BAT was introduced as a key principle in the IPPC Directive. The Directive includes a definition of BAT in article 2.11 [1].

Every word of the BAT notion was defined separately (Table 1.).

This definition shows that BAT not only cover the technology used but also the way in which the installation is operated. This ensures a high level of the environmental protection as a whole. Best available techniques take into account the balance between the costs and the environmental benefits.

The one of the procedures for BAT selection presented in Figure 1.

Table 1.  
Components of the BAT notion [1-3, 7]

B	“best” in relation to techniques, means the most effective in achieving a high general level of the environment protection as a whole.
A	“available techniques” means those techniques developed on a scale which allows implementation in the relevant class of activity under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced within the State, as long as they are reasonably accessible to the person carrying out the activity.
T	“techniques” includes both the technology used and the way in which the installation is designed, built, managed, maintained, operated and decommissioned.

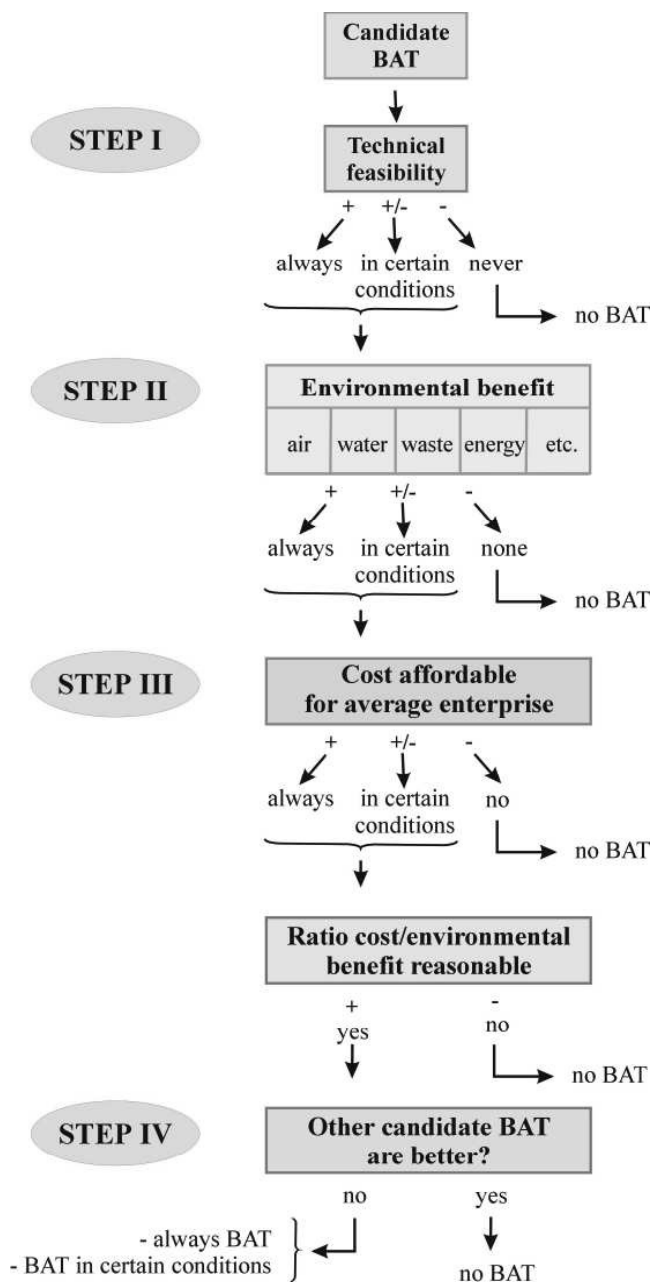


Fig. 1. Procedure for selection of BAT [7]

It has been worked out by Flemish Institute for Technological Research (Vito).

This procedure takes into account technical feasibility, environmental benefit (minimum emissions to air, water, minimum quantity of waste and minimum energy consumption) and economical feasibility of many solutions which apply for best available techniques.

In defining of best available techniques, special considerations should be given to the items listed in Annex IV of IPPC Directive, among others [1, 8-10]:

- the use of low-waste technology,
- the use of less hazardous substances,
- the furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate,
- comparable processes, facilities or methods of operation, which have been tried with success on an industrial scale,
- technological advances and changes in scientific knowledge and understanding,
- the nature, effects and volume of the emissions concerned,
- the consumption and nature of raw materials (including water) used in the process and their energy efficiency.

So, we can affirm, that applying BAT requirements makes possible sustainable development (SD) achievement [11]. BAT are the basis of cleaner production and ISO 14001 standard [12-14].

The European IPPC Bureau has prepared reference documents called BREF outline “best available techniques” applicable to the individual industrial sectors.

BREFs do not prescribe techniques or emission limit values. However, the BREFs will inform the interested parts about what may be technically and economically available to industry in order to improve their environmental performance and consequently improve the whole environment (towards SD) [2, 3].

The works over BREFs carried on by Technical Working Groups (TWG) contain 30 categories of industrial activities and some intersectorial (vertical) problems [3].

#### 4. Integrated recycling technology

Experiences in connection with the waste recycling show, that there is no universal method of their processing and removing from a rubbish dump.

None of them guarantees the total waste reduction, and except of recovered products, they generate new waste which second processing required. Increasing waste quantities require the continuous search and using of new technological solutions in the practice. Such methods and technologies which do not require large financial expenditures, are available and do not require negative influence on the natural environment are advisable. Using of the integrated recycling technologies is the most rational [15].

The notion “integrated” defines the connection and adaptation to oneself of elementary technological processes which in the result of the integration of their working create one universal, complex technology, and co-operating with oneself intensified their effectiveness. The integrated recycling technology has to be

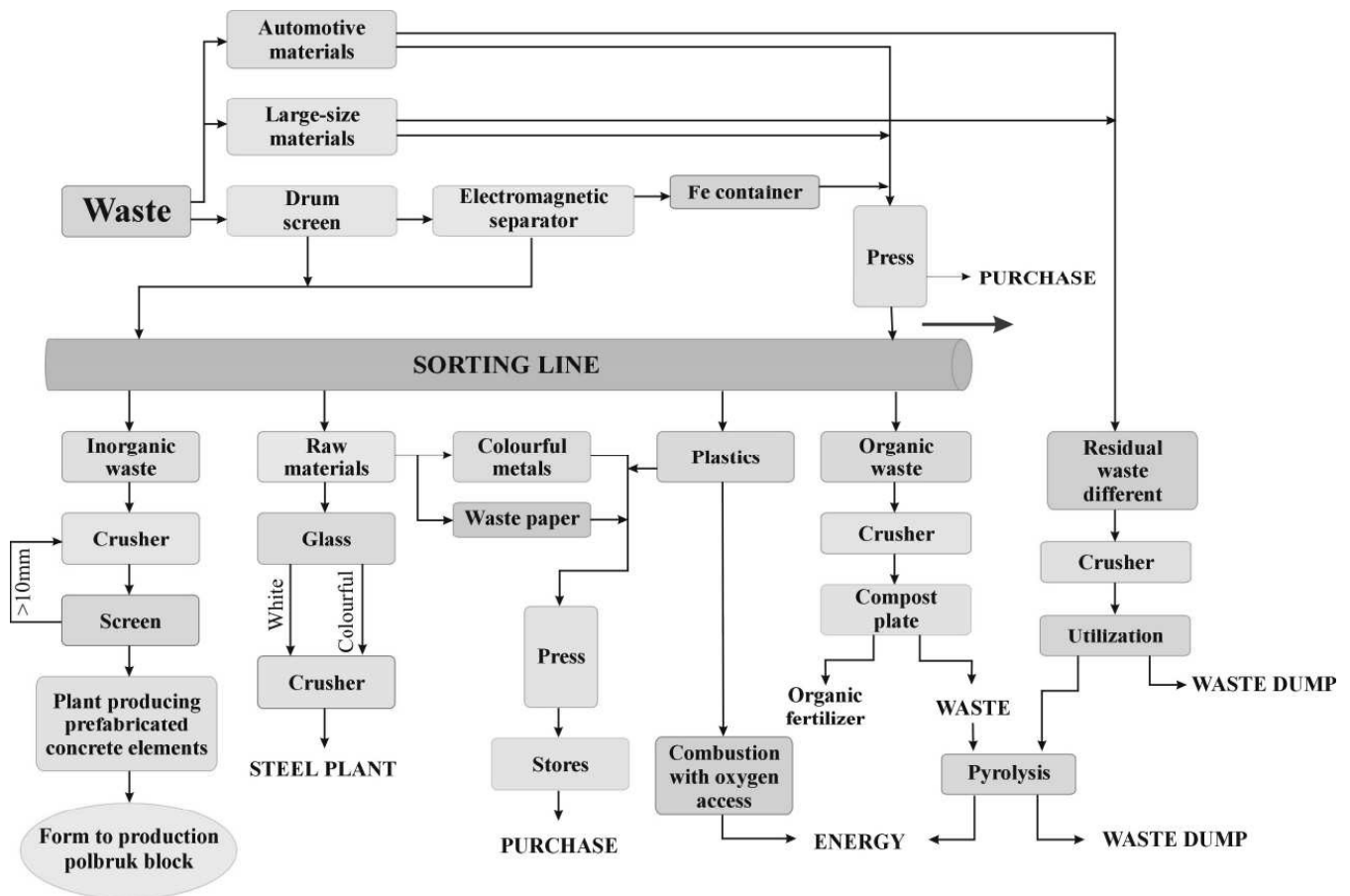


Fig. 2. Schema of the proposed integrated recycling technology model

so universal to make possible complex processing and recovery of waste which do not be selection on useful products early, eliminating the necessity of their deposit in a rubbish dump. It means that the preliminary segregation and separation of waste differing in fractions in this case are useless. Creating such technology should consider factors, which influence on the quantitative and qualitative waste indicators, and especially all ecological requirements and financial condition.

#### 4.1. Model of the integrated recycling technology

The conception of the integrated recycling technology requires spacious knowledge concerning of basic raw materials go into composition of mixed waste. The improper selection of the technology can contribute to the occurrence of problems connected with raw materials deficiency or dissipates difficult exploitation and production of successive waste.

After the accurate analysis and the comparison of the main recycling technologies applied in the practice, we can distinguish new possibilities and tendencies of future using in the field of waste management. Basing on recycling techniques and technologies used, their similarities, defects and advantages, and aiming to the largest advantages achievement in relation to economic and ecological area, the model of the integrated recycling technology was designed (Fig. 2.).

This model characterizes generality, frankness and elasticity what means that it can be adapted to various social-economic conditions and does not require earlier waste sorting. It does not generate too high costs (in comparison with expenditures born by particular recycling technologies) and the most important thing - it is ecological and technically practicable. The advantage of this technology is the fact, that in contrast to others recycling technologies, during process carried out additionally do not form others waste, but the useful products. The above-mentioned features permit in the future (taking into consideration necessary investigations and additional improvements) include the proposed integrated recycling technology model to BAT.

## 5. Conclusions

In the Member States environmental permits contain technology-based requirements. Best available techniques are a reference point in the establishment of permit condition for all installations in the European Union.

Taking into consideration scores for technical feasibility, ecological improvements, acceptable cost and comparison with other candidate BAT, the integrated recycling technology can be the best candidate for best available techniques in the future.

The model of the integrated recycling technology makes possible the identification and second waste processing of various

groups of materials on the example of one production plant. Because of that, it concentrates many useful devices in this aim.

The construction of the total and universal recycling system is the unusually difficult undertaking; therefore so important are continuous investigations towards total waste reduction.

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