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Katedra Mechaniki i Podstaw Konstrukcji Maszyn

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Review of

Phd thesis MSc., Eng., Massimiliano Pedot - „Manufacturing process diagnostic and damage assessment of HSLA steel butt-welded pipelines”

The review of the doctoral thesis was commissioned by the Chairperson of the Discipline Council of Mechanical Engineering of the Silesian University of Technology prof. dr hab. inż. Ewy Majchrzak of December 2, 2022 r.

1. Work characteristics

The problem of diagnostics of production processes is a very important procedure. It is important both in terms of economy and safety of manufactured products. The work deals with the analysis of manufactured pipelines by their welding. The output material is pipes made of HSLA steel. As you know, the mere execution of individual elements does not guarantee the subsequent correct operation of the devices. Therefore, it is very important to assess the damage in order to analyze the correctness of their execution and subsequent failure-free operation. Therefore, the topic taken up by the doctoral student in the reviewed doctoral dissertation of Mr. M. Pedot is the most up-to-date and fits perfectly into such analyses.

The work takes 140 pages with attachments. This size is the standard size for this type of work. The basic content of the doctoral thesis is contained on 112 pages. At the beginning of the work there is a table of contents, and then the whole is presented in 8 numbered

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paragraphs, a list of cited literature and an appendix divided into 3 subparagraphs. Unfortunately, the summary of the thesis written in the language of the doctoral dissertation was not found at the end. Unfortunately, the whole work was not preceded by a list of more important markings. Including a list of more important markings is a good practice, because it makes the work more readable. A detailed comment on this statement will be provided later in this review.

In the first paragraph of the doctoral dissertation, the Author placed an introduction to the problem considered in the work. In the aforementioned introduction, the author included a short description of the problem with a short description of the subject of the study and the premises for writing the thesis. The scope of the work is relatively broadly described. A description of the proposed research to be carried out as part of the doctoral thesis is also presented. Unfortunately, it is difficult to find clearly written purpose and thesis of the work. The purpose of the work can be found in the background of the dissertation. However, the main goal is casually written on page 6. It could rather be emphasized more in the work. In the next, second paragraph, problems in petrochemical plants are schematically presented, with particular emphasis on piping systems used in this type of plants. In the case of pipe systems, possible ways of obtaining pipes, their connection and typical possible connection configurations of such pipes are presented. In the third paragraph entitled Welding processes and diagnostic methods, the basic welding technologies are described at the beginning. Then it was indicated that the technology of joining by welding often leads to various defects. In this way, the imperfection of this process and the need for diagnostics of the connections obtained in this way were demonstrated. The possibility of non-destructive methods has been demonstrated for this purpose. In particular, radiographics and thermographic techniques are presented. The next paragraph is the paragraph on the preparation of pipe samples with butt-weld joints. This paragraph is divided into two subparagraphs. In the first one, samples with induced imperfections in different welding methods (vertical and horizontal) and different welding technologies were described. In the second subparagraph, samples made in an optimal way are described. Various technologies of welded pipe joints are also presented here. The fifth paragraph deals with the quality assessment of defective samples. This description is divided into three subsections depending on the welding technology used. In turn, in the sixth paragraph, the author presented destructive tests of samples taken from welded pipes. The first subparagraph of this paragraph presents destructive tests with static tension and three-point bending with three welding methods used. The second subparagraph presents impact tests

with optimally made samples. In this case, numerical calculations were also made with calculations of displacement and stresses during impact compression of pipes in the direction perpendicular to the diameter. The last substantive paragraph is the eighth paragraph on monitoring the welding process. Here, in the next three subsections, the critical condition in pipe specimens made according to various welding technologies are described. The last numbered paragraph is the conclusions. This paragraph has been prepared in a non-standard way, namely it has been divided into four subparagraphs. In fact, the first three subsections are the analysis of the production process, the analysis of defective samples, and the analysis of damaged samples. Only the last subparagraph entitled "Final considerations" contains conclusions. Unfortunately, it was done in a descriptive way. It would be worth highlighting a few basic conclusions in points.

The most important achievements of this doctoral dissertation include:

- Observation of butt-welded joint pipes manufacturing process;
- Assessment of the influence of imperfections on the behaviour of welded joints;
- Analysis of the behaviour of real scale pipe specimens under catastrophic loads;
- Definition of a method for the detection of the imperfections inside the joints.

The paragraph entitled "Bibliography" lists 73 items. Among them there is one item co-authored by a PhD student. Much of the literature cited is textbooks, standards, and other items that are not scientific articles. No date of access is given when citing websites.

The presented achievements indicate the significant scientific contribution of this doctoral dissertation, its innovativeness, the legitimacy of the undertaken topic with particular emphasis on its practical importance in the economy.

Despite the generally positive review of the doctoral thesis of Msc., Eng., Massimiliano Pedot, what was written in the description of the thesis and the most important achievements of the doctoral student, I included some doubts in the detailed comments and questions about the thesis. The vast majority of these comments do not affect the substantive quality of the work, but if the doctoral student had avoided these errors, the work would be easier to read and more valuable.

2. Detailed comments and questions about the work

Basic notes and questions for work are:

- in the opinion of the reviewer, it would be good, as mentioned earlier, to add a list of markings at the beginning of the work. Then it would be easier to read the work. It should be

noted here that some of the markings are Polish, not international ones. In any case, the yield point is not defined anywhere $R_{10.5}$. Please define this material property. The designation $R_{0.2}$ is more popular. Besides, on page 82 in Fig. 99 the value $R_{0.2}$ is incorrectly presented (there should be a limit of proportionality R_H here) and next to it in table 40 is $R_{10.5}$. Please explain what is shown in Fig. 99;

- The list of more important symbols could also include more important abbreviations used in the work. What about, for example, shortcuts GMA, MMA, SSA it would be very reasonable. These abbreviations are defined in the work several times (p. 14, 29, 39);

- decimal fractions in accordance with the rules of the English language (the PhD thesis was written in this language), should be written as periods, not commas. Unfortunately, fractions are usually written with commas, i.e. in accordance with the rules of the Polish language, which is a mistake in a work written in English;

- tables are not properly described. Captions should be above tables, not below;

- some units are spelled inconsistently with units SI. We often encounter inconsistencies. The units of measure of length are written differently „m, mm, cm”. In addition, a unit of time „d” appears in Table 1. It would be better to write „day”, no unobvious abbreviations;

- p.614 – it is written „In the previous paragraph...”. However, there was no paragraph before that. I guess this passage is taken from an earlier version of the work or another work;

- p.1118 - it is written “[17], [18], [19], [20]”. It should be “[17-20]”;

- Table 3 is unnecessarily split into two pages;

- p.30¹⁶ – it is written „CO2”. It should be “CO₂”;

- p.652 – it is written “mAmin”. It should be written “mA·min” or “mA·s” (SI);

- p.84 – on the fig. 103 and 104 defined Huber-Mises stresses. However, please explain what the units in these figures are defined as „Effective Stress ($v \cdot m$)” and how these units relate to fractional values on the scale;

- the scope of work was given in detail. However, please indicate to what extent the doctoral student participated in the research.

English is not the primary language for both the doctoral student, supervisor and reviewer. I do not consider myself an expert in English by any means, but I have to say that some of the text clearly has linguistic shortcomings or shortcomings. However, the work can be read with understanding.

In addition, there are numerous punctuation errors in the work. No dots at the end of sentences, no commas when enumerating. However, these are typical editorial errors that, unfortunately, almost always appear in this type of work.

At the end of the analysis of the doctoral thesis, the question arises - Does the doctoral student have speeches at conferences and publications in addition to the doctoral thesis and one cited work? Additional publications are not necessary, but such information more fully characterizes the doctoral student.

Additionally, an abstract in Polish was added to the original paper. I am aware that someone helped in the preparation of this summary. It is incomprehensible in places. Here, of course, the doctoral student may not know it, but the title is not translated into Polish, and on page 4 of this abstract there is a comment about the error. It should be noted here that this commentary is neither in Polish nor in English, which the doctoral student should notice after printing.

3. Comments and general conclusions

The presented characteristics of the work and few comments regarding the work, both substantive and editorial, show that the dissertation shows a great understanding of the problem presented in the work in the field of both diagnostics of the production process and the subsequent assessment of damage to HSLA welded pipelines. This applies to the performance of research, calculations and analyzes in this area carried out by MSc., Eng., Massimiliano Pedot. The comments contained in the review may be the subject of analysis in the further research and publication activities of the doctoral student, and may also be useful in editing subsequent scientific papers. It should be noted here that some of the comments are questions and suggestions to be used in the future. At this point, the question arises whether the PhD student considered the durability problems of pipes welded in this way. Specifically, the question is about the aspects of diagnostics in terms of rheology and fatigue of pipes loaded with operational values? The question obviously goes beyond the scope of the PhD, but it can be used in further work. It should be pointed out that the reviewed doctoral thesis is an interdisciplinary work and could be placed in two scientific disciplines: Materials Engineering and Mechanical Engineering, with the latter as the dominant one. Therefore, the work was placed in the appropriate discipline.

4. Final conclusion

The entire evaluation of the doctoral dissertation allows for the formulation of a conclusion that the conditions set out in the Law on Higher Education and Science of July 20, 2018, as amended, are sufficiently met. I apply for the admission of the dissertation of MSc., Eng., Massimiliano Pedot titled „Manufacturing process diagnostic and damage assessment of HSLA steel butt-welded pipelines” for public defense of the doctoral thesis at the Silesian University of Technology in accordance with the procedure in force at the University.

Kind regards

A handwritten signature in blue ink, appearing to read 'Pedot', with a stylized flourish at the end.