

SOME ASPECTS OF A METALLURGY CONSULTING IN THE INDUSTRIAL TRANSITION OF B&H

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Keywords: plastic deformation v.s. mechanical maintenance in the industrial transition, metallurgy consulting

ABSTRACT

Some specific aspects of metallurgy consulting in the industrial transition of Bosnia and Herzegovina are presented in this paper. The theoretical part of the paper is mostly concerned with a short overview of ZELJEZARA ZENICA cum ARCELORMITTAL-ZENICA (AMZ) product-mix and the facilities transition, as an example of the a.m. transition, although these parameters are realistic in the practice. In the practical part, some judicial cases-pictures related to the plastic deformation of the structures-facilities are presented, along with general proposals-solutions how to overcome the problems related to an occurrence of plastic deformation of the a.m. structures-facilities, through proper mechanical maintenance, management, and consulting with renown institutions. The figures supplied in the practical part express the significant extent of the plastic deformations and are taken from the court expert judicial cases in different B&H companies. It may be an incentive for the technical faculties and institutes in B&H to visit metal sector production plants and offer their consulting services, in order to prevent the (dangerous) occurrence of plastic deformation of the structures-facilities, which can lead to worker injuries, structure-machinery breaks and to the un-planned stopping of normal production.

1. INTRODUCTION

U and I-beams are commonly used structural steel shapes in building industrial facilities and fixing the different types of machinery for the metal sector production [1].

Besides the recuperation of the infrastructure, as a war-ravaged country, B&H is still in the process of an industrial transition from unprofitable to profitable industry production [2].

A sort of very clear and metallurgy-oriented example of that industrial transition is ZELJEZARA ZENICA cum ARCELORMITTAL-ZENICA (AMZ) product mix and the facilities transition, along with mechanical maintenance of these facilities.

A simple comparison related to the final product mix, the facilities, and along with the characteristics of mechanical maintenance regarding the a.m. example is presented in the theoretical part of this paper comprising the content of the Table1.

In the practical part, some pictures of plastically deformed structures-facilities are presented. These pictures were taken from judicial cases related to different companies in B&H. They reflect the consequences of plastic deformation occurrences. Such overloading (could be produced by many reasons) which is a reason for plastic deformation occurrences can be produced by many technical reasons and unexpected events (like earthquakes and/or similar events), but can be also the consequence of a sort of poor mechanical maintenance, or negligence of the initial signs of the plastic deformation occurrences, or of an attempt to minimize mechanical maintenance expenses.

Whatever the reason is, there is a need to prevent the (dangerous) occurrence of plastic deformation of the structures-facilities, which can lead to worker injuries, machinery

breaks, and unplanned stopping of normal production [3]. That is why it is advisable that a related staff from the technical faculties and institutes in B&H go to visit metal sector production plants, advise their management and offer their own consulting services.

2. THEORETICAL/PRACTICAL APPROACH TO THE INDUSTRIAL TRANSITION REGARDING ŽELJEZARA ZENICA cum ARCELORMITTAL-ZENICA (AMZ)

As an example of a theoretical and at the same time practical approach in industrial transition, there is the case of ZELJEZARA ZENICA cum ARCELORMITTAL-ZENICA (AMZ) product-mix and the facilities transition, along with the characteristics of mechanical maintenance of these facilities.

Table 1. ŽELJEZARA ZENICA cum ARCELORMITTAL-ZENICA (AMZ) product mix and facilities

| No. | ŽELJEZARA ZENICA - Final product facilities/products | AMZ- Final product facilities |
|-----|--|-----------------------------------|
| 1 | Blooming/blooms | - |
| 2 | Continuous billet mill (after Blooming)/billets | - |
| 3 | Continuous billet mill (after CC machine)/billets | - |
| 4 | Heavy section mill/heavy sections | - |
| 5 | Medium section mill/medium sections | - |
| 6 | Light section mill – continuous/light sections | <u>Yes (improved one-working)</u> |
| 7 | Light section mill - line train mechanized/light sections | - |
| 8 | Light section mill - line train 320 mm – manual/light sections | |
| 9 | Light section mill - line train 280 mm – manual/light sections | |
| 10 | Wire rod mill - continuous/wire rod | Yes (the same one-working) |
| 11 | Wire rod mill - semi-continuous/wire rod | - |
| 12 | Single pass mill/ultra light sections | - |
| 13 | Forging shop/free forged & rolled pieces | <u>Yes (the same one-off)</u> |

It is easy to notice from Table 1 that only two continuous rolling mills from former ZELJEZARA ZENICA operate nowadays in ARCELORMITTAL-ZENICA, and even one of them needed a high investment to be improved for meeting the requirements of profitability in a modern market economy.

The only excess or new final product facility in ARCELORMITTAL-ZENICA v.s. ZELJEZARA ZENICA is a Cold rolling-drawing mill, supplied with meshes & girders welding facilities.

Comprising all workforce including the one from preparatory and molten metal facilities (Coke oven, Sinter plants, Blast furnaces, Steel shops), Quality control, Transportation, Gas-Energy & Control-Measurement units, along with Maintenance units, and Food & Catering service units, there were about 22 000 workers in ZELJEZARA ZENICA in 1990-ies (production was about 1,8 million t/y), and nowadays, there are about 2 000 workers in ARCELORMITTAL-ZENICA (production was-is about 0,8 million t/y).

From the theoretical point of view, it is advisable to optimize production in a process of an industrial transition, to work on the best performance facilities, and to reduce labour force as well as maintenance expenses, as ARCELORMITTAL-ZENICA does in practice, but at a same time, it increases the risk of collapsed or damaged facilities, due to a lack of a proper pre-emptive oriented maintenance.

3. PRACTICAL APPROACH TO THE METALLURGY CONSULTING ORIENTED ACTIVITIES IN B&H METALLIC AND NON-METALLIC SECTOR

Besides that enormous a.m. mentioned ARCELORMITTAL-ZENICA reduction in labour force and accordingly higher profitability, there is also higher profitability-oriented practice to reduce proper maintenance, which is nowadays more full-wearing oriented, instead of more pre-emptive oriented maintenance.

There are also similar a.m. problems in the other metallic and non-metallic materials sector companies in B&H.

Figures 1 to 7 supplied in the practical part of this paper, express a significant extent of the plastic deformations, which lead to the break of a structure in a metallic material production plant, and similar figures 8 to 11 express also a significant extent of the plastic deformations, which did not (yet) lead to the break of a structure in a non-metallic material production plant. They are both taken from the court expert judicial cases in different B&H companies.



Figure 1. A broken sort of portal crane



Figure 2. Western layout view from a broken portal crane



Figure 3. Eastern layout view from a broken portal crane



Figure 4. Detailed position of a heavy bended section of a broken portal crane



Figure 5. Detailed position of a deeply corroded section of a broken portal crane



Figure 6. Detailed position of a welded and deeply corroded section of a broken portal crane



Figure 7. Detailed position of the small ductile breaks of a broken portal crane section



Figure 8. Detailed position of the wooden and steel section supports to plastically deformed sections



Figure 9. Another position of the wooden and steel section supports plastically deformed sections



Figure 10. Detailed position of the wooden section supports to plastically deformed sections & roof



Figure 11. Detailed position of plastically deformed sections & roof

All figures are very illustrative and easy to understand for the teaching staff from metallurgy and materials engineering faculties or institutes, as well as for the mechanical engineering ones. Such combined teams might organize visits to metallic and non-metallic product factories around B&H to convey some advice and messages about the dangerous consequences of any extent of plastic deformation occurrence on the structures and machinery.

Special attention during these proposed visits should be paid to the potential reasons for the occurrence of any (dangerous) extent of plastic deformation such as:

- A- insufficient safety coefficient in designing
- B- overloading
- C- welding spots treatment
- D- insufficient or non-regular corrosion protection
- E- chemically aggressive environment
- F- heating and freezing conditions (especially at welding spots)
- G- vibrations and shocks
- H- other reasons

It is not the aim of this article to treat from a metallurgy or material science point of view the a.m. problems from A to H, that can cause an occurrence of any (dangerous) extent of plastic deformation on different steel structures, than to give an incentive for more frequent visits of the teaching staff to the industrial facilities presenting at a spot short review of the a.m. topics, namely from A - H.

On the other hand, it is also advisable to make the Faculty of Metallurgy and Technology, Zenica, more visible among the companies-institutions in B&H and in the region, because it is illustrative in figures 1 to 11 that there could be a lot of potential "patients" having a

sort of similar problems (since the companies these photo-figures are taken from, are well known and respected companies in B&H, so one could imagine what is a situation in less known companies).

One more useful action to enhance an offer of "metallurgical" consulting activities is to make the application be recognized and registered in the Federal Ministry of Justice, as the institution for consulting activities in the area of metallic and non-metallic materials along with related technologies (as well as in all area corresponding to the study programs of Faculty of Metallurgy and Technology, Zenica).

Another area to enhance an offer of technical-technological consulting activities could be organized along with any Faculty of Mechanical Engineering, since from my experience, the majority of the transition companies in B&H are keen to reduce labour force as well as maintenance expenses, but that practice at a same time increases the risk of collapsed or damaged facilities, due to a lack of a proper pre-emptive oriented maintenance. Daily, weekly, and monthly maintenance periods are advisable to be a part of a production diagram, especially if the facilities are dated from the last century.

3. CONCLUSIONS

1. An overloading (or bad welding spots treatment, insufficient or non-regular corrosion protection, chemically aggressive environment, heating and freezing conditions /especially at welding spots/, vibrations, shocks, and some other unexpected reasons) can lead to an occurrence of plastic deformation, and all that can be a consequence of a sort of poor mechanical maintenance, or of the negligence of the initial signs of the plastic deformation occurrences.
2. It is advisable to optimize production in a process of an industrial transition, to manage production on the best-performance facilities, and to reduce labour force as well as maintenance expenses, but at the same time, it increases the risk of collapsed or damaged facilities, due to a lack of a proper pre-emptive oriented maintenance.
3. Regular visits of the teaching staff or experts to the industrial facilities presenting at a spot short review of the a.m. topics presented in the first conclusion are advisable.
4. It is also advisable to make the Faculty of Metallurgy and Technology, Zenica, more visible among the companies in B&H and in the region because it is illustrated in Figures 1 to 11 that there could be a lot of potential "patients" having a sort of similar problems.
5. For enhancing an offer for "metallurgical-technical" consulting activities it is needed to make the application to be recognized and registered in B&H Federal Ministry of Justice, as the institution for consulting activities in the area of metallic and non-metallic materials along with related technologies, as well as in all area corresponding to the study programs of Faculty of Metallurgy and Technology.
6. Another area to enhance an offer of technical-technological consulting activities could be organized along with the Faculty of Mechanical Engineering, since from my experience, the majority of the transition companies in B&H are keen to reduce labour force as well as maintenance expenses, but that practice at a same time increases the risk of collapsed or damaged facilities, due to a lack of a proper pre-emptive oriented maintenance. Daily, weekly, and monthly maintenance periods are advisable to be a part of a production diagram, especially if the facilities are dated from the last century.

4. REFERENCES

- [1] F. Uzunović and the others, Survey of the selected sector, published by USAID – BBAC, USAID, Sarajevo, December 1997

- [2] S. Tomašević and F. Uzunović: Restructuring of the steel industry in 1990, with a special view to the rolling technology in developing countries, especially in I-beam production, The first metallurgical symposium of Iran, Teheran 1991
- [3] F. Uzunović, O. Beganović, and L. Sušić L.: The latest improvements in I-beams production and its application in building and maintenance, 7th International Conference MAINTENANCE 2022