INTRODUCTION OF THE CP CONCEPT IN A FACTORY FOR THE PRODUCTION OF WELDING ELECTRODES - PIVA, PLUŽINE

The new concept of Cleaner Production (CP) was recently introduced in the Factory for the production of welding electrodes (FEP) in Plužine, by following some activities, raw materials and products. By the identification of some sub-processes with CP opportunities, focus points were identified and subjected to some technical modifications and innovations. The most significant results were obtained regarding waste waters, through the modifications of existing waste water generation and a possible switch to an other technology, the reduction of K-silica waste through a technological modification, a system of powder transport, as well as the production of coated electrodes.

Key words: welding electrodes; welding; CP opportunities; waste waters treatment; coating powders.

EXPERIMENTAL

The overall scheme of the technological process in the FEP plant is given in Figure 1.

The factoty for the production of supplementary materials for welding in Plužine (FEP) has been fully operational since 1986. It produces 62 supplementary welding materials in 5 different dimensions. The maximal annual production capacity of FEP is: 3500 t of coated electrodes for the REL welding procedure, 1500 t of wires for welding in CO2 gas protection, 500 t of wires for welding by the EPP procedure and other solid wires, 500 t of civil engineering nails, 200 t of filled electrode wires. The company uses various raw materials in the form of wires, powders as well as toxic materials in the form of active substances and solvents. During the production process, non-toxic waste is generated and disposed inside the company’s premises. Non-toxic waste includes: non-recyclable waste, powder materials, coal cinder and ashes, metal waste. Liquid waste consists of waste oils, waste waters and other. Waste oil is stored within the company, while waste water is effused in the sewage after chemical treatment. The company does separate non-toxic waste such as powder waste, metal waste, coal slag and municipal waste. The municipal waste itself is not yet treated according to legal instructions. Considering toxic waste minimization, mostly originating from the sulphur acid solution bathubs operation, some improvements can be made through the general repair of the plant or by replacement with a more up-to-date technology. Awareness of the weak points directs the future activities toward: the reduction of solid non-toxic waste through raw materials management and recycling, some technical modification of the sulphur acid solvent technology for wire purification, as well as complete process modernization. Substantial improvements can be made in the efficiency and quality of waste waters.
Waste waters are generated on the line of surface treatment and wire preparation in the operation of sulphur acid bathtubs, during dry and wet extrusion, on the etching line as well as the coating-with-copper line and the neutralization line. Figure 2 presents the scheme of the generation and treatment of rinsing waters.

The existing system for waste water treatment consists of: an automatic system for in-site neutralization (water collector, flocculation bath and neutralization vessel), a system for the automatic flocculant and lime dosage, a lamellar depositor, a bath for the final pH control and a pumping system for effusing into a natural recipient, an automatic system for suspension treatment (suspension collector, bath for the suspension treatment, lamellar depositor, vessel for the final pH control, a mud depositor, mud pumping, briquette presses and a pumping system for water effusion into the natural recipient).

Three phases of system rationalization were performed in this study:
- reclamation of the existing equipment followed by water quality monitoring on the FEP premises,
- water consumption rationalization by recycling technological water in the process and
- reduction of the water consumption by introducing mechanical decapators for forged waste extraction on the dry extrusion lines.

The treated waste water is not effused into a natural recipient, but recycled in the process (Figure 3, dashed line) thus enabling savings of 3.6 m³/h of water. The savings depend on the production intensity. The former effusion pump for the natural recipient was used for the aforementioned purposes. The final rationalization phase prepared two decapators for mechanical forged waste extraction together with a change in the dry extraction technology, giving the possibility of 50,000 € direct savings.
Inside rising waters-idea

- Collecting of rising waters: t = 24 min, Q = 17.4 m³/h
- Neutralization: t = 24 min
- Flocculation: t = 25 min
- Precipitation in laminar collector: t = 37.5 min
- Final pH control
- Effusion in natural recipient
- Pump: 3.6 m³/h

Figure 3. Scheme of rinsing water in situ treatment as a function of treating time in different technological phases.

The environmental savings obtained by avoiding the sulphur bath, waste water treatment and control are significant. Figure 4 presents the Fe, Cu and SO₄ chemical analysis of the waste waters. The alignment with the maximum allowed concentrations according to Montenegrin legislative is obvious.

The investigation concerning the system of powder transport and production of coated electrodes focused on the reduction of air pollution and technological losses.

Electrode coating preparation, according to Figure 5, is performed through several phases: automatic dosage and weight measurement, dry and wet homogenization of the specimen for the coating preparation, the process of briquette preparation, deposition of the coating on the wire, electrode drying and packing.

The system for automatic weight measurement serves for weighing the coating constituents according to the recipe, as well as for the pneumatic transport of the constituents toward the blender for each electrode type. Blenders are used for the dry and wet homogenization of the constituents and binder (K-silica), (Figure 6) according to the widely accepted procedure for all the electrode types. The parameters that vary as a function of electrode type are time and mixing speed.

Briquette presses serve for the briquette preparation, from homogenized powders (dry and wet homogenization). Presses deposit the coating of specific height on the wire, at a pressure that varies according to different electrode types.

In chamber furnaces drying is performed according to a well known regime. The drying time is a function of electrode type. The annual production of powder waste is cca 28 t. It could be identified as (Figure 7):
- technological loss during transport, weighing and dosage of powders,
- recyclable paste which is exposed to the milling process and returned to the production 54.48 % and
- paste which is deposited on the dump (43.57 %, 12.5 t).

Figure 4. Chemical analysis results for the waste waters.

In the weighing system, powder transport is enabled by means of a pressure difference with the working fluid TNG (4.5-5 bar). A new idea of transport was completely established in the FEP plant. The old transport was replaced by a new one (ejection transport), where the consumption of working fluid per time and
the same quantity of powders was reduced from 9 to 5.5 m³/min. On the other hand, the pressure in the system was reduced from 4.5-5 bar to 1.8 bar (Figure 8). The pipeline length was reduced by 14 m and the number of curves from 12 to 3, thus enabling a significant reduction of losses in the pipeline. Beside the extension of the filter bag working efficiency, the mixing of working paths was disabled. The overall dust quantity in the area of the weighing machine was reduced from 19.48 to 9.80 mg/m³.

K-silica has the role of binder on the line of coated electrode production. The working efficiency on the presses depends on the silica viscosity. It also depends on temperature and the quantity of water in the solution. The K-silica temperature is supported by two heating machines, 10 kW each. The existing heating system was replaced by a heat exchange unit. The losses of K-silica were reduced up to 80% which was a considerable impact on the environment.

CONCLUSIONS

The aforementioned activities had the following effects:

− environmental pollution by waste waters was disabled after the optimization. The level of dangerous substances found by chemical analysis fully supports that statement. By means of mechanical extraction of the forged waste (decapator introduction), considerable energy savings and water consumption reduction were achieved,

− ejection powder transport reduced air pollution as well as technological losses on the production line and

− a heat exchanger and intensive mixing in the system of storage and dosage of K-silica enabled more efficient pressing.

REFERENCES

[1] FEP internal documentation from the UNIDO project “The Introduction of CP in Montenegro”, Internal publication of Faculty of Metallurgy and Chemical Technology Podgorica, 2007