

MedClean Propre Limpio


No. 53
Pollution prevention case studies

Cleaner production in black metallurgy

Company background

DD «ŽICA», Sarajevo (Sarajevo, Bosnia and Herzegovina), was established in 1950 as a working department for wire and nail production originally separated from the steel factory Zenica. During the period from 1950 to 1962, the industry produced wire and nails with constantly increasing production from 3,000 tons to 27,000 tons per year, and increasing number of employees from 225 to 630.

Following the economic development of the country, the production in the factory increased, both by quantity and assortment. In 1985, production reaches approximately 186,000 tons of different products, while in 1990 the production was 120,000 tons with 2,000 employees.

Industrial sector

Production of wire and wire-like products using cold rolling process.

Environmental considerations

The major problems in black metallurgy are:

- excessive water consumption and wastewater generation;
- excessive energy consumption (electric energy and natural gas);
- excessive consumption of lubrication materials, chemical substances, etc.;
- complex treatment requirements for wastewater and other waste products generated in the production process.

Background

The industrial process of wire rolling consists of the following steps:

1. Preparation of wire surface for rolling:
 - chemical preparation in H_2SO_4 (12-18%) or HCl (15-20%) baths to remove iron oxides (FeO , Fe_3O_4 and Fe_2O_2) from the wire surface
 - washing in hot water (90°C)
 - neutralization with lime at high temperature (85-95°C)
 - copper plating to prevent corrosion and phosphate plating to enable higher rolling speeds, further processing of wire to finish product and prevent corrosion
 - drying in ovens at temperatures ranging from 0-350°C
2. Rolling followed by thermal treatment for the purpose of changing the structure of steel wires.
3. Zinc, copper or phosphate plating depending on the type of wire unwinding:
 - pre-heating in soluble lead baths at 600°C and plating in zinc/copper baths
 - wiping and cooling
 - winding

The analysis of the industrial process revealed the following problems:

- Excessive water consumption in the production line.
- Excessive energy consumption in the form of electric energy, gas and steam.
- Excessive consumption of chemicals: sulphuric acid, inhibitors, lime, phosphate, copper sulphate, etc.
- Large quantity of water needed for recycling.
- Large quantity of sludge that should be recycled before disposal on the municipal solid waste landfill site.
- The wastewater treatment plant was destroyed during the war activities.

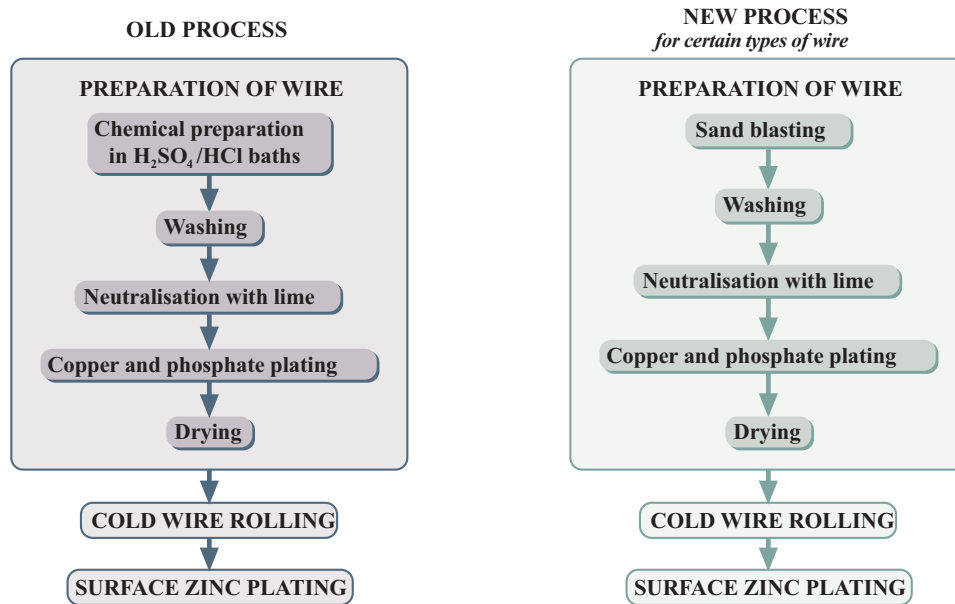
Summary of actions

Detailed analyses of the technological process showed that chemical preparation of wire surface for rolling accounts for most of the costs in the production chain. This process produces enormous quantities of wastewater that should be treated before reuse or discharge into the water stream.

After detailed analyses of the technological process and the latest achievements in science and technology, it was decided to introduce a new technological process of wire surface preparation prior to rolling, based on blasting by sand. It was anticipated that this would provide revenue and help in problems with wastewater generation.

According to the new technological solution, chemical preparation of wire is avoided in 90% of production, which eliminates the use of chemicals and water, and decreases energy consumption as well.

Diagrams



Balances

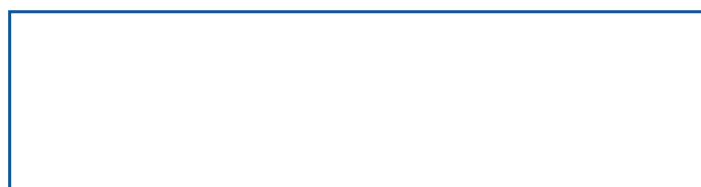
	Old process		New process	
	Quantity	Cost (€)	Quantity	Cost (€)
Material balance				
Sulphuric acid	195.5 t	18,049	0	0
Inhibitor	579,458 kg	5,823	0	0
Carbamide	579,458 kg	5,823	0	0
Lime	9,414 kg	965	0	0
Water	17,383 m ³	23,174	0	0
Natural gas	13,035.6 Nm ³	4,010	0	0
Steam	1,448,400 kg	40,852	0	0
Electric energy	225,226.2 KWh	15,592	173,815 KWh	11,969
Steel sand	0	0	72,423 t	3,714
Wastewater neutralisation	17,338 m ³	35,565	0	0
Water fee		18,461		4,923
Total expenses		168,314		20,606
Savings				147,707 €/y
Investment				297,435 €
Payback period				2.013 years

Conclusions

Along with environmental benefits, the wire factory achieved enormous economic benefits by decreasing consumption of electric energy by 86.57% and total expenditures by 87.76%. The complete program was developed for production level in 2002, i.e. 7,242 tons of wire treated with sand blasting. The payback period for this investment is 2.013 years. If this program had been developed at the production level of 1991, the payback period would have been approximately 1.68 months.

NOTE: This case study seeks only to illustrate a pollution prevention example and should not be taken as a general recommendation.

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