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Regional Activity Centre for Cleaner Production

MINISTERIO DE MEDIO AMBIENTE

Generalitat de Catalunya
Government of Catalonia
Department of the Environment and Housing

No. 26 Pollution prevention case studies

Replacement of cyanide salts in the cementation process of steel parts

Company background	Construcciones Mecánicas Domènech (Olot, Spain).
Industrial sector	Machining and assembly of power transmission components.
Environmental considerations	Parts of the geared-wheel, cogwheel, general gearing and axle, etc. -type, are subject to a two-stage heat treatment at an intermediate stage of the process. One of these is cementation (surface treatment to protect from friction and corrosion) and the other is tempering. The cementation process consists in adding carbon to the surface of the part at a specific penetration. These parts are deposited in ovens where, by using molten cyanide salts (that act as a fuel medium), the reductive atmosphere that works in forming the enriched cementation layer on parts is produced. The temperature, the time parts are in the ovens and the fuel media that are used are the factors that determine the depth of cementation. The heat treatment ends with a tempering stage by oil or water bath, depending on the characteristics of the steel, the purpose of which is to obtain the required hardness. The use of these salts as a fuel medium involves the production of molten salts as well as the production of corrosive vapours that damage the facility's metal structure.
Background	The factors that led the company to make this change were the possible effect on the environment associated with the handling and storage of these salts, the complexity of the inertisation treatment of this special waste element and the incidence of the use of these cyanide salts in the working conditions of the company.
Summary of actions	The company replaced the cyanide salts with a hydrocarbon (methyl alcohol). The reductive gas is produced by a hydrocarbon controlled drip system that, when ignited within a furnace chamber (oven), produces the cementation or reductive atmosphere. This replacement involved the redesign and replacement of the cementation ovens, of their heating system and of the tubing and control units. Once the required cementation depth has been attained, the part goes on to the production line.

Diagrams

OLD UNIT

NEW UNIT

Balances

	Old process	New process
Balances of material and energy		
Consumption of cyanide salts	3,349 kg/year	0 kg/year
Consumption of methyl alcohol	0 l/year	820 l/year
Generation of special wastes associated with this stage	2,850 kg/year	0 kg/year
Electrical consumption of cementation	465,150 kWh/year	118,200 kWh/year
Consumption of gas natural	0 m^3/year	18,725 m^3/year
Economic balances		
Cost of cyanide salt consumption	11,072.3 €/year	0 €/year
Cost of methyl alcohol consumption	0 €/year	1,652.8 €/year
Cost of cyanide waste management	8,173.8 €/year	0 €/year
Cost of electrical consumption	50,736.8 €/year	8,882.2 €/year
Cost of natural gas consumption	0 €/year	10,127.1 €/year
Cost of facility maintenance	8,392.3 €/year	2,424.9 €/year
Savings		
Consumption of cyanide salts		11,072.3 €/year
Waste management		8,173.8 €/year
Consumption of energy		31,727.1 €/year
Facility maintenance		5,967.4 €/year
Investments		
Investment in facilities		€186,185.0
Payback period		3.3 years

Conclusions

The replacement of raw materials with other materials that pollute less have meant a 100% reduction at source of the waste generated in the process under study as well as a reduction in risk to the environment and to people with no change in the quality of the product sold. It should also be mentioned that, with this initiative, the company is preventing the production of a waste that involves difficulties both in transport and subsequent treatment.

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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