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No. 148 Pollution Prevention Case Studies

Use of Water Vapour for a Refrigeration Unit

Company	Solvay Martorell
Industrial sector	Manufacture of plastics and synthetic rubber in primary forms ISIC Rev. 4 no. 2013 (International Standard Industrial Classification of All Economic Activities)
Environmental considerations	To buy a new refrigeration unit, avoiding the use of an electrical refrigerator compressor, with savings in electricity consumption.
Background	Solvay's factory in Martorell in an integrated facility, whose size and efficiency levels are among the best in Europe. This factory supplies the plastic processing sector. The following products are manufactured in this plant: choline, caustic soda, hypochlorite, hydrogen and PVC. Solvay's factory in Martorell produces polyvinyl chloride (PVC) in three phases: *1. Chlorine synthesis* Based on such basic commodities as salt and electricity, and through a process of electrolysis, Solvay obtains the required chlorine and a number of key products for the industry: caustic soda, hydrogen, sodium hypochlorite and hydrochloric acid. The salt used in Solvay is obtained from one of the waste streams from potash mining in a nearby location. *2. Manufacture of monomeric vinyl chloride (VCM)* The procurement and manufacture of vinyl chloride monomer is done through the thermal cracking of dichloroethane, which consists of three stages: (a) the mixing of chlorine and ethylene, obtaining 1, 2-dichloroethane; (b) pyrolysis of the dichloroethane, forming vinyl chloride and hydrogen chloride; (c) the mixing of hydrogen chloride with ethylene and oxygen, obtaining 1,2-dichloroethane. In this process, hydrochloric acid and high-pressure water vapour are recovered as by-products for other uses in the facility. *3. Production of PVC* The polymerization reaction of vinyl chloride is carried out in suspension, in a medium containing water, monomer, an initiator and a dispersing agent. The polymerization reaction takes place in every drop of VC, which is transformed into a grain of PVC, the final product being a suspension of PVC grains in water, which are separated by centrifugation and dried in fluidized beds.
Summary of actions	PVC production needs cold to refrigerate the water circulating through the polymerization reaction sleeves. The temperature achieved in the refrigeration towers is not enough, so it requires a contribution from compressor cooling devices. Instead of using the existing electric refrigeration unit (with a consumption of 235 kWe/MWt), the company decided to buy a new absorption refrigerator that used the pressure vapour exuded from the VCM unit and that used low-pressure water vapour, with a consumption of 6 t/h.

	Budget Absorption refrigerator — €308,000 Installation (mechanical) — €35,000 Instrumentation and electrical assembly — €12,000 Total — €355,000 Engineering — €15,000 **TOTAL** — **€370,000**

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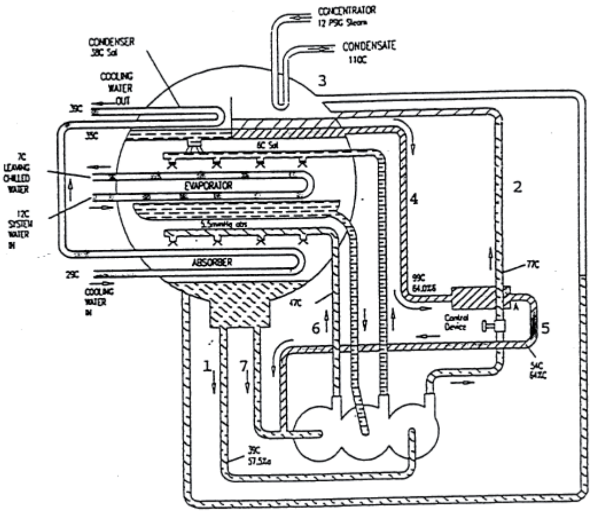
Diagram



Balances

SAVINGS (energy)

S = 3,5 - 2,625 = 0,875 MWt, equivalent to S = 0,875 MWt * 235 kWe/MWt = 205,6 kWe

S = 205,6 kW * 24 h/d * 365 d/y = **1,801,275 kWh/year**

SAVINGS (economic)

S' = 1,800 MWh/y * €70/MWh = **€126,000/year**

RETURN ON INVESTMENT

The return-on-investment period has been calculated as **3 years**.

Conclusions

Through an initial investment in new equipment, instead of using an already existing device, the company was able to significantly reduce the energy consumption of the process, allowing a relatively short return-on-investment period.

The company also reuses a by-product from other processes, the water vapour, which would otherwise be released into the atmosphere.

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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