Solar Heating in Industrial Processes (SHIP) Project

The project “Utilizing Solar Energy for Industrial Process Heat in Egyptian Industry” is financed by the GEF and implemented by UNIDO in partnership with the Egypt National Cleaner Production Centre ENCPC. The objective of the project is to develop the market environment for the diffusion and local manufacturing of solar energy systems for industrial process heat. The project results will increase the knowledge and strengthen the awareness among the major stakeholders on the penetration potential of solar technologies in the food, chemical and textiles sectors in the region. The project focuses on improving the energy efficiency of the industrial process heating systems and the introduction of solar thermal technologies mainly in industrial companies that have low and medium temperature heat demand in three industrial sectors, namely the food, chemical and textiles sectors.

Phatrade - Pharaonic Essential Oils Co. – Obour City Plant Case Study

1st Industrial Zone, Obour City, Egypt

Food Sector Essential Oils

7,475 kg/year

1,139,970 kWh/year thermal energy consumed

Phatrade - Pharaonic Essential Oils is part of the food sector for essential Oils products in Egypt. Phatrade has been established in 1975 in the Spices and herbs field and started essential oils and concretes and absolutes products in 1987. The production of Phatrade company is assigned for the local and export markets. Phatrade – Obour City factory is one of the two operating Phatrade factories.

Phatrade – Obour City factory’s processes flow diagram exhibits the main processes performed on the raw material to produce Cumin, Neroli, Parsley, Thyme, Chamomile and Anise oils products. General analysis on the thermal energy consumption shows that the average specific diesel consumption is about 152.6 kWh/Kg which is much higher than the average worldwide specific energy consumption benchmark.

Thermal energy system is supplied through a steam boiler of 1 Ton/hr capacity and supply steam at 6.5 bar. The analysis shows that it is operating at part load most of the time and has about 0.43 ton/hr average steam production. Applying the suggested optimization measures will eliminated unnecessary losses and the factory can operate at much lower cost.

- Optimization Opportunities -

Thermal Insulation

Boiler Optimization

Waste Heat Utilization

Solar Water Heating

Production Processes Flow Diagram

Raw material receiving
Inspection
Packing raw material in stills
Steam distillation
First oil filtration
Aeration for essential oil
Second Oil filtration and packing
Storage
Final filtration and packing
Shipping
Thermal Insulation
Insulation of pipes and fittings is a general principle that should be applied in all steam consuming processes in the factories. The proposed solution is to fix the insulation at multiple parts of the steam system. The collective saving from proper insulation is usually enormous. Insulation will help to reduce energy consumption, CO₂ emissions, and operation costs. Safety will be enhanced after reducing surface temperature from 170 °C to 45 °C.

Capex: 21 USD/meter
Energy Savings: 1,800 kWh/year/meter
Payback: 0.26 years
CO₂ Reduction: 0.48 tCO₂/year

Optimizing Boiler’s Blowdown Flow Rate
Using a fixed rate of blowdown does not take into account changes in makeup and feed water conditions, variations in steam demand or the actual concentration of dissolved solids in the boiler’s water. The proposed solution is to install an automatic control system optimizing blowdown rates. This will reduce energy consumption, treatment, CO₂ emissions, and operation costs.

Capex: 7,000 USD
Energy Savings: 57,760 kWh/year
Payback: 2.8 years
CO₂ Reduction: 15.5 tCO₂/year

Integration of Solar Thermal Heating System
Solar heating technologies collect thermal energy from the sun and this heat can be used for heating purposes. Solar collectors are selected based on the range of the operating temperature range and the type of the industrial sector. Heat in the lower temperature range (<100 °C) can easily be provided with systems commercially available, such as flat plate collectors (FPC) and evacuated tube collectors (ETC). The scenario envisioned for the factory is to preheat boiler feed water by recovering energy from boiler’s exhaust gases and blowdown water followed by heating using solar system which will decrease the energy consumed by the boiler. The system will be installed on the roof occupying 110 m² of area. The system is designed to heat 5.2 m³/day to 95 °C. The system cost is around USD 54,950 and the annual savings will be USD 5,945. Other parameters are shown below.

Lessons Learnt
• Thermal insulation is a quick win. It saves energy with very low upfront costs and have high impact and low payback.
• Boiler optimization requires low efforts but have high impact on CO₂ emissions reduction.
• Waste energy utilization is not a common measure, however highest energy saving can be achieved by this measure.
• Solar thermal integration combines renewable energy resources utilization and energy savings measures.

The total proposed solutions summary:
• Thermal Energy Savings: up to 413,340 kWh/year, representing about 36.3% savings of the total thermal energy consumption (where 13.3% is due to the integration of SWH systems),
• Financial Savings: 44,690 USD/year,
• Capital Cost: ~69,270 USD,
• Overall Payback Period: 1.55 years,
• CO₂ Emissions Reduction: 180 tCO₂eq/year.

Improvement in Burner Efficiency with an Oxygen Analyzer
The excess air is not automatically controlled in the boiler, thus the air to fuel ratio is not optimal and leads to an increased fuel bill. The proposed solution is to install an online combustion gas analyzer and manual adjustment of the air damper to improve burner efficiency. This requires low capital cost and results in huge CO₂ emissions and operation costs reduction.

Capex: 1,750 USD
Energy Savings: 9,470 kWh/year
Payback: 4.7 years
CO₂ Reduction: 2.6 tCO₂/year

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