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. – Sadat City Plant Case Study

Shebin ElKom Sadat Rd., El Beheira, Egypt

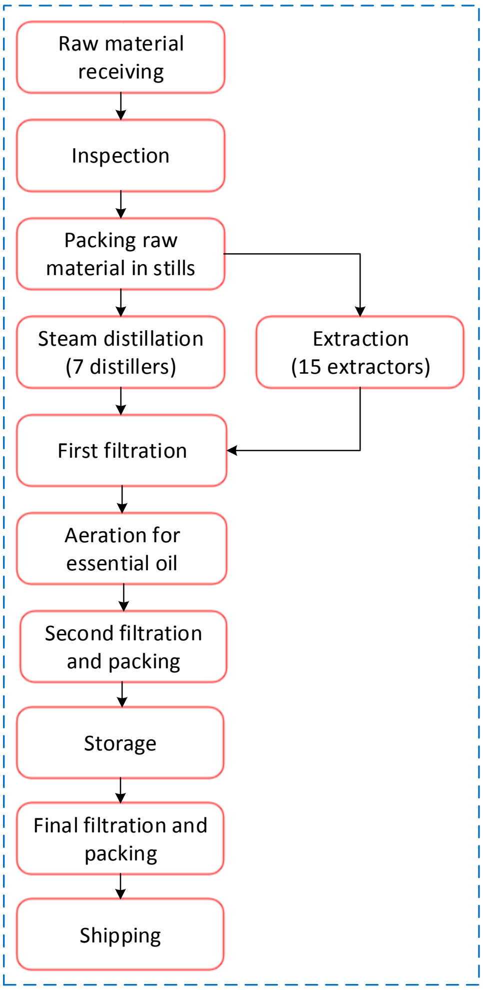
Food Sector

Essential Oils

12 – 14 Tons/year

1,984,000 kWh/year thermal energy consumed

Production Processes Flow Diagram



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 – Sadat City factory is one of the two operating Phatrade factories.

Phatrade – Sadat City factory's processes flow diagram exhibits the main processes performed on the raw material to produce Petitgarin Mandarin, Parsley, Coriander, Geranium Oils and Jasmine and Bitter orange concretes products. Since the factory does not have data documentation system, the consultant tried to estimate the consumption based on the data provided for the similar Obour factory using some assumptions and analogy estimations from and it shows that the average specific energy consumption is about 152.6 kWh_{th}/Kg which is much higher than the average worldwide benchmark.

Thermal energy system is supplied through **two steam boilers**, the main and standby boilers capacities are 4 and 8 tons/hr respectively and supply steam at **8 bar**. 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

Thermal Insulation

Insulation of pipes, fittings and tanks 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**, **CO_2 emissions**, and **operation costs**. **safety will be enhanced** after **reducing** surface temperature from **175 °C to 35 °C**.

Capex: 21 **USD/meter**
Energy Savings: 4,795 **kWh/year/meter**
Payback: 0.2 **years**
CO_2 Reduction: 1.3 **tCO_2/year/meter**

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**, **CO_2 emissions**, and **operation costs**.

Capex: 7,000 **USD**
Energy Savings: 159,930 **kWh/year**
Payback: 1.1 **years**
CO_2 Reduction: 43 **tCO_2/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 **CO_2 emissions** and **operation costs reduction**.

Capex: 1,750 **USD**
Energy Savings: 28,900 **kWh/year**
Payback: 1.5 **years**
CO_2 Reduction: 8 **tCO_2/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 exhaust gasses 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 **30 m^2** of area. The system is designed to **heat 11.5 m^3/day to 95 °C**. The **system cost** is around **USD 14,250** and the **annual savings** will be **USD 4,250**. Other parameters are shown below.

System Design Area: **30 m^2 using ETC**

Energy Savings: **108,055 kWh/year**

Capex: **14,250 USD**

Annual Savings: **USD 4,205**

Payback: **3.4 years**

CO_2 Reduction: **29 tCO_2/year**

Water Flow Rate: **11.5 m^3/day**

Design Temperature: **95 °C**

Lifetime: **20 Years**

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 CO_2 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 **967,550 kWh/year**, representing about **48.7%** savings of the total **thermal** energy consumption (where **5.4%** is due to the integration of SWH systems),
- **Financial Savings: 89,110 USD/year,**
- **Capital Cost**: **~33,530 USD**,
- **Overall Payback Period: 0.4** years,
- **CO_2 Emissions Reduction: 407 tCO_2eq/year**.

For more information:

UNIDO Project Management Unit in Egypt,
Email: info@shipprojectegypt.org
Phone: +20 102 895 1112
www.SHIPprojectEgypt.org

UNIDO Headquarters:

Mark Draek,
Email: m.draeck@unido.org
Phone: +43 (1) 26026 4356

SCAN ME

SOLAR Heating for Industrial Process
Together Toward Efficient Production