UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

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.

Lotus Garments – Suez Canal Plant Case Study

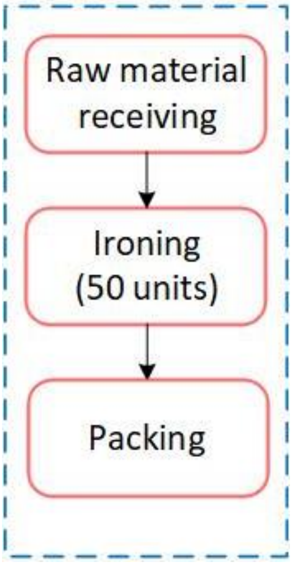
Public Investment Free Zone, Port Said, Egypt

Textile Sector **Ironed Garments**

8,850,580 Pieces/year

2,091,815 kWh/year thermal energy consumed

Production Processes Flow Diagram



Lotus Group is part of textile sector for manufacturing supportive consultation and production services from raw fiber to finished garments through about 8000 employees, operating since 1994. The production of Lotus Group is assigned for export to different markets including the top brands in European and US chain stores.

Suez Canal factory is one of the Lotus factories that includes only one process of ironing the raw material to produce the finished ready-to-wear garments. Suez Canal factory contains about 50 ironing units that operate using steam.

Thermal energy system is supplied through **one steam boilers** of 0.5 Ton/hr capacity and supply steam at **8 bar**. The steam is used directly for the manufacturing processes. The boiler is fire tube boiler using **diesel** as fuel source.

If the suggested optimization measures were applied, unnecessary losses will be eliminated, and one boiler only can operate efficiently to supply the system at much lower cost.

- Optimization Opportunities -

Thermal Insulation

Boiler Optimization

Waste Heat Utilization

Solar Water Heating

Thermal Insulation

Insulation of pipes, tanks, fittings, and machines 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. Insulating steam pipes will help **to reduce energy consumption**, **CO_2 emission**, and **operation costs**. **safety will be enhanced** after **reducing** surface temperature from **170 °C to 34 °C**.

Capex: 20 **USD/meter**
Energy Savings: 3,968 **kWh/year/meter**
Payback: 0.13 **years**
CO_2 Reduction: 1.28 **tCO_2/year/meter**

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 gas bill. **The proposed solution** is to **install an online combustion gas analyzer** and manual adjustment of the air damper to improve burner efficiency. This **proposed solution** requires **low capital cost** and results in huge **CO_2 emission reduction**.

Capex: 1,750 **USD**
Energy Savings: 59,755 **kWh/year**
Payback: 0.75 **years**
CO_2 Reduction: 16 **tCO_2/year**

Optimizing The Flow Rate Of Blowdown In The Boiler

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: 61,830 **kWh/year**
Payback: 2.85 **years**
CO_2 Reduction: 16 **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 **192 m²** of area. The system is designed to **heat 12 m³/day to 95 °C**. The **system cost** is around **USD 100,550** and the **annual savings** will be **USD 11,320**. With lifetime of **20 years**, the **total savings is USD 113,200**. Other parameters are shown below.

System Design Area: 192 m² using ETC
Energy Savings: 287,655 kWh/year
Capex: 100,550 USD
Annual Savings: USD 11,320
Payback: 8.9 years
CO_2 Reduction: 77 tCO_2/year
Water Flow Rate: 12 m³/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 energy consumption and CO_2 emissions reduction.**
- **Waste heat 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 702,790 **kWh/year**, representing about 33.6% savings of the total **thermal** energy consumption (where 13.8% is due to the integration of SWH systems),
- **Financial Savings:** 27,670 **USD/year,**
- **Capital Cost**: ~110,630 **USD**,
- **Overall Payback Period:** 4 **years**,
- **CO_2 Emissions Reduction:** 192 **tCO_2eq/year**.

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SOLAR Heating for Industrial Process
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