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 – Fresh Tex 2 Plant Case Study

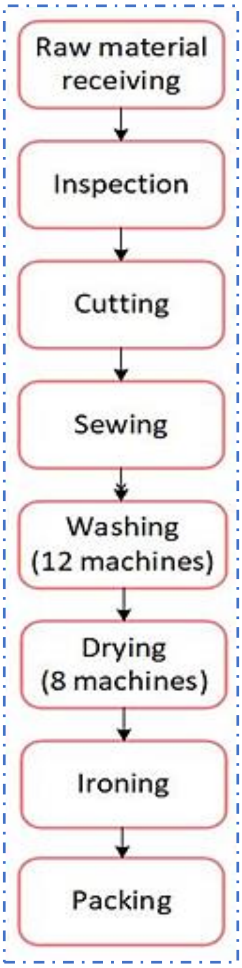
Public Investment Free Zone, Port Said, Egypt

Textile Sector **Garments**

4,757,180 Pieces/year

22,220,720 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.

Fresh Tex 2 factory is one of the Lotus factories that its processes flow diagram exhibits the main processes performed on the raw material to produce the finished ready-to-wear garments. General analysis on the electrical and thermal energy consumption shows that **electrical consumption** represents **22.2%** from the total energy consumption while **natural gas consumption** represents **77.8%**.

Thermal energy system is supplied through **two steam boilers** of 4 Ton/hr capacity each and supply steam at **8.8 bar** and using natural gas 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 -

Waste Heat Utilization

Boiler Optimization

Solar Water Heating

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 **proposed solution** requires **low capital cost** and results in huge **CO_2 emission reduction**.

Capex: 1,800 **USD**
Energy Savings: 143,860 **kWh/year**
Payback: 0.7 **years**
CO_2 Reduction: 29 **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: 627,500 **kWh/year**
Payback: 0.64 **years**
CO_2 Reduction: 127 **tCO_2/year**

Heat Recovery From Boiler's Exhaust Flue Gases

According to the measurements, the boiler's exhaust is around 160 °C therefore, there is a potential to utilize the waste heat from the exhaust stream before discharging it to the atmosphere. This can be done either for boiler's air preheating or boiler's feed water preheating (economizer). This will Preheat the feed water **up to 55 °C**. This measure will **reduce energy consumption**, **CO_2 emissions** and **operation costs**.

Capex: 1,885 **USD**
Energy Savings: 110,580 **kWh/year**
Payback: 3.6 **years**
CO_2 Reduction: 22 **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 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 **30 m^2** of area. The system is designed to **heat 7 m^3/day to 95 °C**. The **system cost** is around **USD 23,600** and the **annual savings** will be **USD 3,285**. With lifetime of **20 years**, the **total savings is USD 39,300**. Other parameters are shown below.

System Design Area: 30 m^2 using ETC
Energy Savings: 192,520 kWh/year
Capex: 23,600 USD
Annual Savings: USD 3,285
Payback: 7.2 years
CO_2 Reduction: 39 tCO_2/year
Water Flow Rate: 7 m^3/day
Design Temperature: 95 °C
Lifetime: 20 Years

Lessons Learnt

- **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 963,880 **kWh/year**, representing about 4.3% savings of the total **thermal** energy consumption (where 0.9% is due to the integration of SWH systems),
- **Financial Savings:** 16,680 **USD/year**,
- **Capital Cost**: ~32,400 **USD**,
- **Overall Payback Period:** 1.9 years,
- **CO_2 Emissions Reduction:** 195 **tCO_2eq/year**.

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SOLAR Heating for Industrial Process
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