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.

Sana Foods Case Study

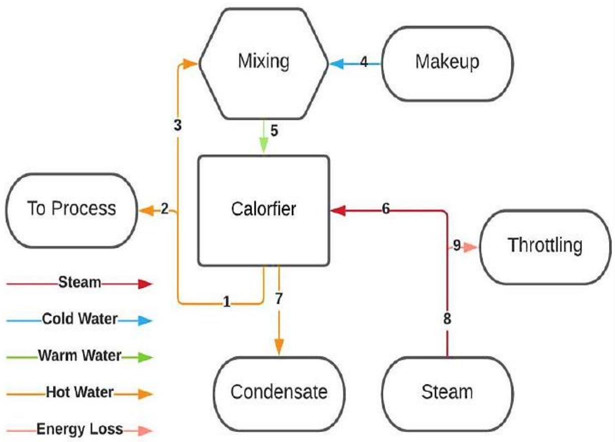
Desouk, El Beheira, Egypt

Food Sector

Sweets Products

6,525,900 kWh/year thermal energy consumed

Block Diagram of The New Water Heating System



Sana Foods is a leading Egyptian company in the field of sweets manufacturing and was established in 1925. The plant has four separate departments; pastries, oriental desserts, western desserts and dry sweets. Each department occupies separate floor in the production building, and has its own production procedures.

This study focused on the new water heating system which aims to supply the whole plant's need of hot water for cleaning and new production purposes via a **central water heating unit**.

The thermal energy system is represented in the mixers and the heated water which is heated using steam in **two** calorific to **65 °C** then circulates in a network covering the whole plant. Steam is throttled and supplied to the calorifics' coils at **4 bars** and **250 kg/h**.

Steam is supplied through **one steam boiler** of 1 Ton/hr capacity and supply steam at **8 bar**. In addition The plant has **46 burners** that are used directly for the ovens and mixers. All burners and the boiler operate by **natural gas**. If the suggested optimization measures were applied, unnecessary losses will be eliminated, and the system can operate at much lower cost.

- Optimization Opportunities -

Waste Heat Utilization

Solar Water Heating

Heat Recovery From Furnaces Exhaust Streams To Be Used In The New Absorption Chiller

Due to the fact that all the ducts of the furnaces exhaust at about **200 °C** are directed towards the roof very near to the new chiller that will be installed. **The proposed solution** is to **install a heat recovery gadget to the chiller that recovers heat**. This solution will help **to reduce fuel consumption**, **CO_2 emission**, and **operation costs**. The estimated savings was about **4%** of the estimated chiller's fuel consumption.

Capex: 4,700 – 6,250 **USD/meter**
Energy Savings: 113,610 **kWh/year**
Payback: 2.4 – 3.2 **years**
CO_2 Reduction: 23 **tCO_2/year**

Heat Recovery From Burners Exhaust Streams To Be Used In The Calorific

This measure is another alternative for the measure of "Heat recovery from furnaces exhaust streams to be used in the new absorption Chiller". **The proposed solution** is to **recover the heat from the exhaust** to heat the water in the calorific in series with the steam. This solution will help **to reduce fuel consumption**, **CO_2 emission**, and **operation costs**. The estimated savings was about **14%** of the estimated calorific' load.

Capex: 3,125 **USD**
Energy Savings: 113,890 **kWh/year**
Payback: 1.6 **years**
CO_2 Reduction: 23 **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).

Two integration scenarios were investigated for the plant to **preheat the feed water of the calorific** which will decrease the energy consumed by the boiler. One scenario is integrating on the base calorific' load and the other on is heat recovering using the 2nd measure followed by HIP integration. The second scenario is more promising and will be **installed on the roof** occupying **110 m²** of area. The system is designed to **heat 56 m³/day to 70 °C**. The **system cost** is around **USD 17,350** and the **annual savings** will be **USD 3,240**. Due to **limited roof area** the system will has a **solar fraction** of **9.6%** only. Other parameters are shown below.

System Design Area: 110 m² using FPC
Energy Savings: 189,720 kWh/year
Capex: 17,350 USD
Annual Savings: USD 3,240
Payback: 5.4 years
CO_2 Reduction: 38 tCO_2/year
Water Flow Rate: 56 m³/day
Design Temperature: 70 °C
Lifetime: 20 Years

Lessons Learnt

- **Waste gas 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 SHIP system design and feasibility are improved when combined with a heat recovery system**

The **total proposed solutions** summary:

- **Thermal Energy Savings:** up to 189,720 **kWh/year**, representing about 3% savings of the total **thermal** energy consumption,
- **Financial Savings:** 3,235 **USD/year,**
- **Capital Cost**: 17,355 **USD**,
- **Overall Payback Period:** 5.4 **years**,
- **CO_2 Emissions Reduction:** 38 **tCO_2eq/year**.

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SOLAR Heating for Industrial Process
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