
DESIGN AND OPERATION OF A LEED PLATINUM RATED BOTTLING PLANT IN CHINA – SWIRE COCA-COLA LUOHE

Abstract: *In 2010, the first Coca-Cola bottling plant in China designed to LEED Platinum standard was in operation at Luohe, Henan province. It employs over 49 sustainability elements reducing 1,200-1,500 metric tonnes/year of GHG emissions and 21,600,000 litres/year of water comparing with conventional design. The key sustainability measures employed include a ground source heat pump system for production; thermal wall insulation; efficient lighting; bloc filling line allowing ambient filling; renewable energy through solar panel and wastewater biogas. Wastewater discharged from the water treatment system is recovered and reused, saving 25 million litres/year of raw water. As part of the site selection process, a source vulnerability assessment was conducted to avoid adverse water impact from future plant operation. Subsequently a source water protection plan was draw-up to ensure sustainable water supply to the plant and the community. This paper will elaborate the challenges encountered during the design stage and evaluate the performance of the plant against the design criteria during operational.*

Keywords: *Beverages; Bottling; Design; Leed; Operation; Sustainable.*

1. Introduction

Swire Beverages is the principal holding company of Swire Pacific's Beverage Division and has the right to produce, market and distribute The Coca-Cola Company's products in Hong Kong, seven provinces in Mainland China, Taiwan and territories across 11 states in Western USA. Swire's partnership with Coca-Cola began in 1965 and has grown to include 16 bottling facilities with over two million square feet of production premises. Swire Beverages covers a total population of 440 million through 18,000 employees, serving over 800,000 customers who sell beverages to consumers. By producing beverages locally, the business aims to bring economic benefits to the local community in the form of investments, job opportunities and taxes, while amplifying this influence through the partnerships with the customers and suppliers for mutual business growth and supporting local development.

2. Swire Coca-Cola Luohe

Swire Beverages celebrated the opening of its most environmental efficient plant to date at Luohe, Henan province in October 2010. The plant is certified to Platinum rating of the Leadership in Energy and Environmental Design (LEED), an internationally recognized green building certification system. The plant has a floor area of 166,000 m² with an annual capacity of more than 100 million unit cases serving not only the demand of Henan's 100 million populations but also part of Shaanxi, north of Jiangsu and Anhui provinces.

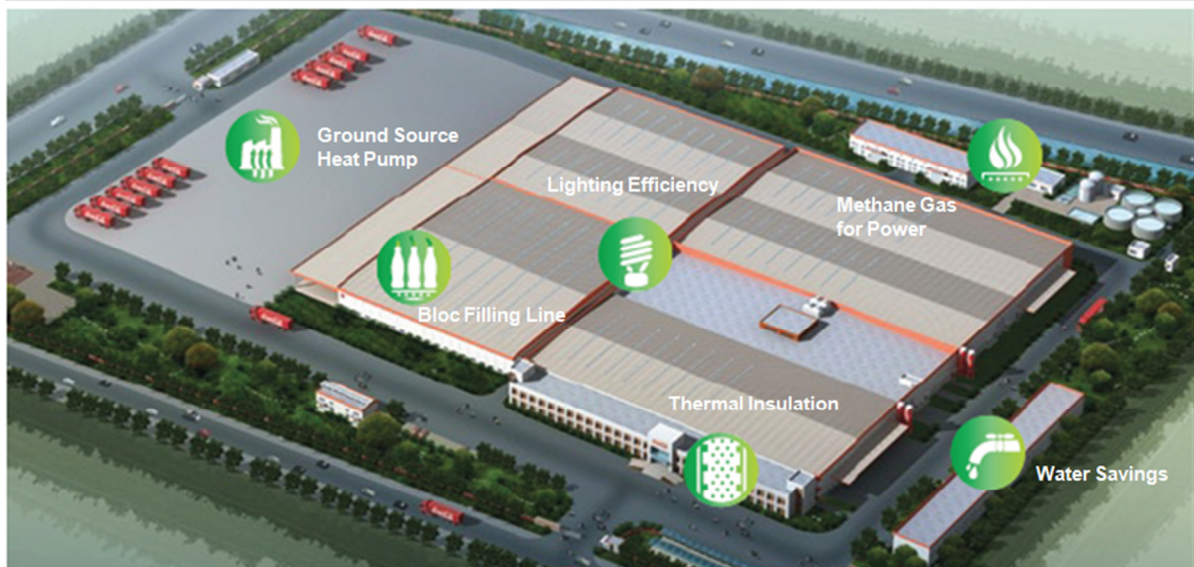


Figure 1: Key Design Features of Swire Coca-Cola Luohe

3. Key Design Features

The Luohe plant employs over 49 sustainability elements and is estimated to reduce 1,200-1,500 metric tonnes of GHG emissions per year and 21,600,000 litres per year of water comparing with conventional design. Chief among these are ground source heat pump; thermal insulation; lighting efficiency; bloc filling line; methane gas for power and water savings.

3.1. Production Energy Efficiency

3.1.1. Advanced Production Equipment and Process

The plant has installed with a high speed production line which comes with eco-driven conveying system. Integrated into the design of bloc filling line, bottle rinsers and air conveyor system between filler and blower can be eliminated. It also enables ambient temperature filling at 20°C that eliminates usage of conventional ammonia compressor for chill-filling and subsequent warming process that brings filled product to room temperature before packaging.

Raw materials come in at room temperature and products come out also at room temperature but significant amount of energy is used for heating and cooling during production. Potentials are identified to recover the waste heat from cooling process and apply it for heating. For example, hot blast generated from PET bottles blowing process is recovered for ambient heating in the packaging workshop at winter. The plant has also adopted an advanced ambient sugar dissolving system which requires heating only to 85°C for pasteurisation with excess heat being recovered.

A combination of these methods reduces the energy consumption of the plant by 1.7M kWh per year comparing with conventional designs.

3.1.2. Methane Gas Recovery and Reuse

The plant is equipped with a wastewater treatment facility to ensure the discharge can be returned to the nature safely. Methane gas generated from the treatment process is conventionally flared. This is, however, recovered in Luohe plant to power a small-sized boiler for steam production, which is then used during production, lessening the need for non-renewable energy sources.



Figure 2: Methane Gas Boiler

3.1.3. Ground Source Heat Pump

The earth's temperature below five meters is normally a consistent 15°C. During summer months, when the earth's temperature is cooler than the air temperature, cold energy is extracted from the earth; while in winter months, heat energy is extracted by circulating water through over 120 kilometers of high density polyethylene piping; which is compiled in a matrix of 800 interconnected vertical boreholes of 50 meter depth underground. The heat pump system provides space heating and cooling to the facility, hot and cold water to the bottling lines and heating to the on-site wastewater treatment facility to improve treatment efficiency. Carbon savings are estimated to range from 20% (cooling) to 40% (heating).



Figure 3: Ground Source Heat Pump (installation)

3.2. Building Energy Efficiency

3.2.1. Prevention of Heat Loss

Heat loss is reduced to a minimum using a combination of methods. The walls of plant buildings are all made from heat insulation materials which insulate heat outside effectively. The building windows are low-E glass which does not only allows natural lighting but also has a two-way energy efficiency ability that prevents heat entering in summer and heat releasing in winter. Approximately, 75% of the workshop roofs are highly reflective, with solar reflectance index of at least 78. Such roofs can effectively reject the solar heat in summer so as to reduce the power consumption of air conditioners. The heat loss prevention methods help reduce the energy consumption by 0.06M kWh per year.

3.2.2. Lighting

The plant has a total surface area of 480 m² reinforced translucent fibreglass roof panels and 52 tubular skylights, which can supply natural light up to 75% of the total production area. A total of 629 units of induction lights were installed in the production and warehousing areas and 232 units of T5 energy saving tubes in the office area. Street lamps in front of the office building are all powered by wind & solar. These measures help cut the energy consumption by 0.2M kWh per year and save 180 tons of carbon emissions to the atmosphere.



Figure 3: Energy Efficient Light Fittings

3.3. Water Savings

The plant has installed with a multi-layered water treatment system to process the incoming water from the main before production use. The discharge from the water treatment, mainly the reject from reverse osmosis process, is recovered, properly treated and completely reused, saving 25 million litres of raw water a year.

Supply water pipe system is made of HDPE which is rigid and highly resistant to corrosion and can lessen the potential for water leakage due to loading impact and corrosion. This helps improve water use efficiency.

3.4. Site Selection and Construction

During site selection, priority is given to potential sites with access to public transportation to reduce the transportation needs for commuting to and from work. A source water vulnerability assessment study has also been conducted to understand the water demand and supply in the area and ensure no negative water stress will be created to the local community during operation. A source water protection plan was drawn up subsequently to ensure sustainability of water supply to the plant and to the community at operation. The plan is reviewed and maintained regularly.

During construction, measures have been taken to minimise the secondary impacts of the project. The measures include balancing cut and fill, recycling of construction materials, proper disposal of wastes and covering bare soil surfaces sprayed. A waste management plan is drawn up with the construction contractor to ensure a minimum 75% recycling rate of construction materials e.g. concrete, steel, brick, wood and glass, etc.



Figure 4: Temporary Cover at Fill Bank

Recycled materials or construction materials with recycled content are used as possible. At least 20% of the construction materials are sourced from 800 km of the site to reduce transportation and encourage local business. Timber from certified sources is used in at least 50% of the materials in the offices.

4. Operational Performance Review and Plan

With over two consecutive years of full scale operation, the sustainability elements incorporated into the design have demonstrated to be effective. The energy and water usage ratios are 0.17 MJ per litre of production and 1.59 litre per litre of production which are 26% and 0.6% respectively better than the company's average in Mainland China. This is the first time the company has applied the LEED standard at its manufacturing facilities and will consider applying the same or equivalent standards on its future development and project.

5. References

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