



DANKOTUWA PORCELAIN LIMITED

Replacement of diesel-fired kiln that uses saggars with gas-fired fast firing kiln

SUMMARY OF THE OPTION

Dankotuwa Porcelain Limited (DPL) is one of the leading porcelain ware manufacturing companies in Sri Lanka. The company's conventional kiln was energy inefficient because it used diesel and a lot of kiln furniture (kiln cars, saggars) that absorbed a lot of energy when transporting green ware through the kiln. This kiln was replaced with a more modern and efficient fast-firing gas kiln that cost US\$ 2.84 million. Annual savings included US\$ 250,000 diesel savings, US\$ 360,000 due to the elimination of the sagger manufacturing department, and increased production of 622 tons per year. The payback period was 4.7 years. Annual environmental savings included 3,535 m³ diesel, resulting in 9,699 tons reduced CO₂ emissions and 87 tons reduced SO₂ emissions. An additional benefit was that due to the elimination of the sagger manufacturing department, space has become available for other manufacturing purposes.

KEYWORDS

Ceramics, Sri Lanka, Fuels and Combustion, Furnaces and Refractories, kiln, Porcelain ware, Saggars

OBSERVATIONS

The kiln used at DPL is energy inefficient because the kiln is old and diesel-fired and is high (about 3-4 meters) compared to more modern kilns. In addition, the conventional kiln uses a lot of kiln furniture to carry the green ware across the kiln. This includes a kiln car (a mobile unit carrying the green ware load through the kiln); saggars (a clay / ceramic base container in which green ware is placed and then covered with a lid to protect the ware from direct heat and polluting materials from the diesel); and other ceramic components to stack green ware items on the kiln car. Generally, kiln furniture consists of about 50% - 80% of the kiln load weight and is especially high in old kiln designs. Kiln furniture therefore consumes a similar proportion of energy during the firing process. The kiln also has high SO₂ emissions, which has also become a serious environmental problem for the company.

In addition, as the conventional kiln uses saggars, DPL has to manufacture saggars and also uses a diesel-fired kiln for this. Sagger manufacturing requires substantial amounts of raw material and energy because the life-time of a sagger is limited to about ten process cycles only.

OPTIONS

Because of the many problems of the existing kiln, it was decided to replace it with a modern, fast firing kiln, which has the following advantages:

- The kiln is lower in height (about 1- 1.5 meter) and therefore less heat loss
- Green ware flows through the kiln at a faster speed, improving energy efficiency
- Kiln furniture is minimized (about 5 – 10% of the total load) and hence, the majority of heat is utilized in processing the green ware
- The kiln is LP gas fired and SO₂ emissions are therefore minimized
- Saggars are no longer needed and therefore the entire sagger manufacturing process can be eliminated



RESULTS

Financial benefits:

- Investment for the fast firing kiln: US\$ 2.84 million
- Annual operating costs: included in annual savings
- Annual cost savings: US\$ 610,000, calculated as follows:
 - Diesel savings from tunnel kiln and sagger kiln (minus gas costs for fast firing kiln): US\$ 250,000
 - Savings from elimination of sagger department (excluding diesel savings): US\$ 360,000
 - Savings through 622 tons productivity improvement: not quantified
- Payback period: 4.7 years

Environmental benefits:

- Annual diesel savings: 3,535 m³, calculated as follows:
 - Specific heat consumption with saggars and other kiln furniture in a conventional Tunnel kiln = 8,000 kcal / kg of white ware
 - Specific heat consumption without saggars and other
 - Kiln furniture in a fast firing kiln = 3,250 kcal / kg of white ware
 - Reduction in specific heat requirement = 4,750 kcal / kg of white ware
 - Annual quantity of white ware manufacturing = 3456.6 M tons
 - Total heat energy saving per annum = 4,750 x 3456.6 x 1000 kcal
 - Total diesel saving per annum due to above heat energy saving (@50% energy efficiency) – (4,750 x 3456.6 x 1000) / 10,800 x 50%
 - Reduction in diesel consumption due to above energy saving (@ 50% energy efficiency level) = ((16418850000 / 10800) kg) / 0.5 = 3040528 kg (= 3,535,498 liters)
- Annual GHG emission reduction: 9,699 tons
- Annual SO₂ Reduction: 87 tons (based on 0.9% average sulfur content in diesel)

Other benefits:

- With the elimination of the sagger manufacturing department, space has become available for other manufacturing purposes.

FOR MORE INFORMATION

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