# Rice Husk Boiler at Textile Processing Mill

## 1 Executive Summary

Installation and operation of Rice Husk Boiler (RHB) at ABC Textile Mills (Faisalabad City) is one of the pilot projects under SCI-Pak project. To overcome the steam requirement of the textile processing, the pilot industry installed 10 ton per hour rice husk fired boiler to replaced carbon intensive furnace oil with carbon neutral biomass. Cost of generating steam comes out to be 72% less than furnace oil resulting in payback of a month.

## 2 Project Purpose

Installation and operation of Rice Husk Boiler (RHB) at ABC Textile Mills (Faisalabad City) is one of the pilot projects under SCI-Pak project (Name of the Textile Mill has not been mentioned due to request of industry to be anonymous)

Natural gas is the major fuel used in the country. Recently, gas demand is not being fulfilled due to its extensive use in the industrial, commercial and domestic activities. There is frequent shut down of the gas in the industry which is hampering industrial activity badly. Industry is looking for different alternatives for the gas. One of the good alternative fuels is the rice husk due to its cheap price, availability in the country and environment friendly nature. Second largest consumption after gas as fuel in the industry is the furnace oil fuel which is expensive and associated with environmental concerns.
ABC Textile Mills has installed Rice Husk Boiler (RHB) at its facility to produce steam by utilizing rice husk as an alternative fuel of furnace oil during shut down of gas in the country. This steam is used in the textile processing.

## 3 Previous Process

Pakistan is a major producer of rice and rice husk, residue of the main crop, can be used as biomass fuel for boilers in industry.

Textile processing is an energy intensive process having 5-8 kg of steam consumption per kg of the output. The steam is indirectly used in process dryers, steam jackets and directly in the winches. The process can't be run without steam.

In Pakistan, the supply of natural gas is disconnected in three months i.e. November, December and January to industrial units owing to increased domestic demand. The usual practice is to continue production by running boilers on furnace oil.
It is apparent from below that the cost to produce 1 ton of steam with furnace oil, when compared with the same with natural gas, is 56% higher. This adds substantial financial pressure on the production facility. Cost of producing the same one ton of steam with rice husk is 72% cheaper when compared with furnace oil and 35% cheaper when compared with natural gas.

## 4 Improved Process

ABC Textiles Mills has been operating this boiler since February 4, 2011. Time required for fabrication, erection and commissioning is about 09 months (fabrication 5, civil work 3, erection 0.75, commissioning 0.25).

RHB is water tube boiler with design capacity of 10 ton steam per hour (446 $m^2$ heating surface area). It is designed on the three pass flow basis. Major components of the RHB are combustion furnace where rice husk is allowed to burn, deaerator, main boiler, economizer and flue gas stack with cyclones and water scrubbing facility. Boiler blow down is about 3% of the total steam produced from the boiler. The TDS limit for blow down is about 3,500 ppm. The overall efficiency of the boiler is 76%.

Rice husk is purchased from different agricultural areas of the country and stacked at the open place. It is manually fed into the combustion furnace and ignited with furnace oil. Combustion is started in the furnace, flame and flue gases along with the ash particles are sucked by the induced draft fan. This flame is passed through the water tubes inside the boiler body and transfers its heat to the water to form steam. One length of the water tube has been extended out of the boiler body, passed through the combustion furnace and then entered into the boiler. The purpose of this extension is to utilize the heat of the furnace walls.

RO treated water (100 ppm TDS), after mixing with the steam condensate is passed through the economizer. It is then deaerator and then fed into the boiler at a temperature of about 95$^{o}$C.

RHB is attached with four cyclones and one wet scrubber. Maximum amount of the fly ash is removed from these cyclones. The remaining very fine ash particles are removed from the wet scrubber where water is showered at the incoming ash laden flue gases to control air contamination. From the scrubber, this flue gas is then discharged into the atmosphere from the stack. This stack is also equipped with water showering. Whenever there is higher ash concentration in the stack gases then this water showering is carried out to control it. The bottom ash is removed from the furnace and disposed in the depressions as land filling material.

Water and steam flow meters are installed at the boiler to measure water and steam flow rates. The temperature and pressure gauges are installed at the flue gases lines, boiler, economizers and boiler feed water tank.

About 240 kg of rice husk is consumed to produce one ton of steam. The production cost of the steam is about Rs. 1680 per ton of steam.

## 5 Project Financing

- Project Cost: Rs. 14,000,000
- The project was financed by the project owner from its internal equity. No external financing was obtained.

## 6 Project Vendor

The project was executed by:

**INDUSTRIAL BOILERS (PVT) LTD**
10-km.G.T.Road, More Eminabad,
Gujranwala-Pakistan.
Tel: 055-3263700
Contact Person: Mian Maqsood Ahmad

# 7 Saving Calculations

| Parameters | Rice Husk | Furnace Oil |
|---|---|---|
| **Net Calorific Value (NCV)-MJ/kg** | 13.44 | 42.60 |
| **Quantity of fuel used (kg/ton of steam)** | 240 | 72.80 |
| **Quantity of steam produced (ton/hr)** | 7.75 | 7.75 |
| **Cost of fuel (Rs/kg)** | 7.0 | 69.0 |
| **Boiler efficiency (%)** | 77 | 80 |
| **Cost of steam per ton (Rs)** | 1,680 | 5,023 |
| **Cost of steam per year-Rs** ***(300 days/year, 1day =24hr)*** | 93,744,000 | 280,283,400 |
| **Tube replacement cost (Rs/yr)** ***(30% of the capital investment after each two years)*** | 2,100,000 | - |
| **Capital cost of the RHB (Rs)** | 14,000,000 | - |
| **Total operational cost per year-Rs ( steam and tube replacement costs)** | 95,844,000 | - |
| **Savings/yr (in comparison of furnace oil boiler)** ***(Rs. 280,283,400 – Rs. 95,844,000)*** | 184,439,400 | |
| **Pay Back (Months)** | 1.0 | - |

## 7.1 Constraints

Following constraints are attached with RHB. One should consider them while deciding for the installation of RHB.

1- Availability of rice husk in the country is limited
2- Price of rice husk is increasing day by day due to its higher demand as boiler fuel. It has been increased three times from Rs. 100/40 kg to Rs. 300/40 kg within one year
3- Other biomasses such as wheat straw, corn cobs etc will have to be considered to use in the RHB for long run operation of the boiler
4- It would be better if high pressure boiler is installed instead of low pressure because of its higher efficiency, lower fuel demand and less ash production
5- After every two years, tubes are replaced (30% of the project cost is required to replace tubes)
6- Storage of rice husk needs larger area
7- Disposal of ash is an issue

## 8 Financial Performance of Project

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cash Flows from operating Activities:** | | | | | | | | | | | |
| Capital Expenditure | (14,000,000) | | | | | | | | | | |
| Revenue from Savings | | 184,439,400 | 3,608,205 | 3,608,205 | 3,608,205 | 3,608,205 | 3,608,205 | 3,608,205 | 3,608,205 | 3,608,205 | 3,608,205 |
| Depreciation | | (700,000) | (700,000) | (700,000) | (700,000) | (700,000) | (700,000) | (700,000) | (700,000) | (700,000) | (700,000) |
| Recurring Cost | | (95,844,000) | (960,000) | (960,000) | (960,000) | (960,000) | (960,000) | (960,000) | (960,000) | (960,000) | (960,000) |
| **Cash Flow** | **(14,000,000)** | **87,895,400** | **1,948,205** | **1,948,205** | **1,948,205** | **1,948,205** | **1,948,205** | **1,948,205** | **1,948,205** | **1,948,205** | **1,948,205** |
| NPV @15% Discount Rate | **84,514,281** | | | | | | | | | | |
| IRR | **530%** | | | | | | | | | | |

## 9 Project Time Line

| Timeline of Project | | Project Duration | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Month 1 | | | | Month 2 | | | | Month 3 | | | | Month 4 | | | | Month 5 | | | | Month 6 | | | | Month 7 | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | | | | | |
| Milestone1 | Feasibility Study for RH Boiler | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Milestone 2 | Fabrication of RH Boiler | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Milestone 3 | Civil Works/ Foundation | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Milestone 4 | Erection | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Minestone 5 | Commissioning | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Milestone 6** | **Start of Steam Generation from RH Boiler** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

## 10 System Schematic