
ENERGY & AMORPHOUS SILICA PRODUCTION FROM RICE HUSK

Global production of rice, the majority of which is grown in Asia, is approximately 550 million tonnes/year. The milling of rice generates a waste material - the husk surrounding the rice grain. This is generated at a rate of about 20% of the weight of the product rice, or some 110 million tonnes per year globally. The husk in turn contains between 15 and 20% of mineral matter the majority of which is amorphous silica. There is a growing demand for finely divided amorphous silica in the production of high strength, low permeability concrete, for use in bridges, marine environments, and nuclear power plants. This market is currently filled by silica fume. Limited supply and high demand has pushed the price of silica fume to as much as US\$1,000/tonne in some markets. Rice husk has the potential to generate 16.5 to 22 million tonnes of ash containing over 90% amorphous silica that could be used as a substitute for silica fume.



The husk has an energy content of about 14 GJ/tonne so that the energy potential world wide would be some 1.5 billion GJ/year, which at US\$5/GJ would have an annual value of US\$7.5 billion. This amount of energy is equivalent to over 1 billion barrels of oil per year.

Rice husk is currently being used for energy production through direct combustion or gasification in many areas of the world. Unfortunately, in almost all of these installations, the ash produced is not suitable for use as a silica fume substitute. Generally there are two shortcomings in the ash by-product from current rice husk to energy technology: first, they can contain unacceptably high concentrations of residual carbon; and second a portion of the amorphous silica has been transformed into crystalline silica, cristobalite. The second of these two problems is the more serious; cristobalite does not have the same pozzolanic (cementitious) properties, as the amorphous form, and in the particle size range at which it would be used in concrete, it is recognized as a potential human carcinogen. The transformation to the crystalline state takes place if the ash is exposed to high temperatures and becomes even more likely if it is exposed to these high temperatures for extended time periods. Most of the current energy generation technologies do not control temperatures well and most allow the ash to remain at high temperatures for a relatively long residence time.

TORBED Process Reactors applied to rice husk combustion and gasification technology utilize a unique reactor configuration that completes the combustion or gasification of husk in a short residence time at precisely controlled temperatures. It has been shown that, using the TORBED reactor technology, an ash can be produced at a moderate temperature that has zero or at most trace quantities of cristobalite and a residual carbon content of 1-4%.

Because of the moderate temperatures used in the TORBED reactor, there is a slight reduction in the usable energy that can be recovered from a TORBED reactor used as a rice husk combustor. However, in some instances this may be compensated for by achieving a much more complete combustion of the available fuel.

The TORBED reactor can be designed into a new facility to combust rice husk for energy production, or this combustor can be retrofitted into an existing facility to replace a current combustor that is producing an unusable ash waste. The capital investment in a replacement combustor will generate an attractive Return On Investment ('ROI') based on the benefits of turning a waste disposal cost into a by-product credit. Similarly, installation of new plant for energy generation will produce an attractive ROI based on both energy and ash values.

A table showing approximate capacities is shown below:

TORBED diameter m	Steam Generation kg/h (lbs/h) at 40 bar saturated	Power Generation KW electrical **	Range of Rice Husk Consumption kg/h (lb/h)**
1.5	3600-5400 (8000-12000)	650-980	725-1700 (1600-3750)
2.0	5400-9500 (12000-21000)	980-1700	1100-2200 (2400-4850)
2.5	9500-15400 (21000-34000)	1700-2700	1900-3600 (4200-7900)
3.0	15400-22600 (34000-50000)	2700-4400	3100-5200 (6800-11500)
3.5	22600-30300 (50000-67000)	4400-5900	4500-7000 (9900-15400)

Note ** based on a Condensing Steam Turbine

Note ++ depends on rice husk quality and whether flue gas recirculation is used

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