Feature Article

Evolution of Boilers in Palm Oil Mills

N Ravi Menon*

SINGLE TUBE LOW CAPACITY FIRE TUBE BOILER

The Lancashire boiler (*Figure 1*) was popular in palm oil mills in the 1960s. This is a single fire tube boiler with the fumace at one end. The hot flue gases will heat the water surrounding the tube and come out of the tube and heat up the bank of super heater tubes before steaming on to the range. This boiler can take widely fluctuating steam loads as is the case in palm oil mills. The boiler is also very reliable and is rugged.

In 1916, Ulu Remis Palm Oil Mill (Kumpulan Guthrie) in Layang-Layang had about six of these hardy British boilers for its operation. As these boilers had low capacities, a number of boilers were needed for mill operation resulting in selection of high capacity water tube boilers. By 1974 when Kumpulan Guthrie built its new 60 t hr^{-1} (tph) mill, the Lancashire boilers were replaced by three water tube boilers.

Amsterdam-based Stork fire tube boilers having capacities ranging from 10 - 15 tph also were popular in smaller mills in the 1970s but now with increased processing requirements, water tube boilers have almost completely replaced the fire tube boilers.

MULTITUBE FIRE TUBE BOILER

Figures 2 and *3* showed the basic configuration of a low range (10 to 20 tph) palm oil mill boiler. In a 20 tph mill, two units of 15 tph boiler steaming at 20 bar pressure used to be quite common. But the problem arises when the boiler throughputs start dropping due to the formation of scales on the outer surface of the tubes. As palm oil mill turbines operate on a non-condensing Rankine cycle, the feed water circuit is an open one with no condensate being returned as in the case of power station where most of the steam is condensed and the condensate returned to the feed water circuit.

* *Malaysian Palm Oil Board,*
6 Persiaran Institusi, Bandar Baru Bangi,
43000 Kajang, Selangor, Malaysia.
E-mail: nravi@mpob.gov.my

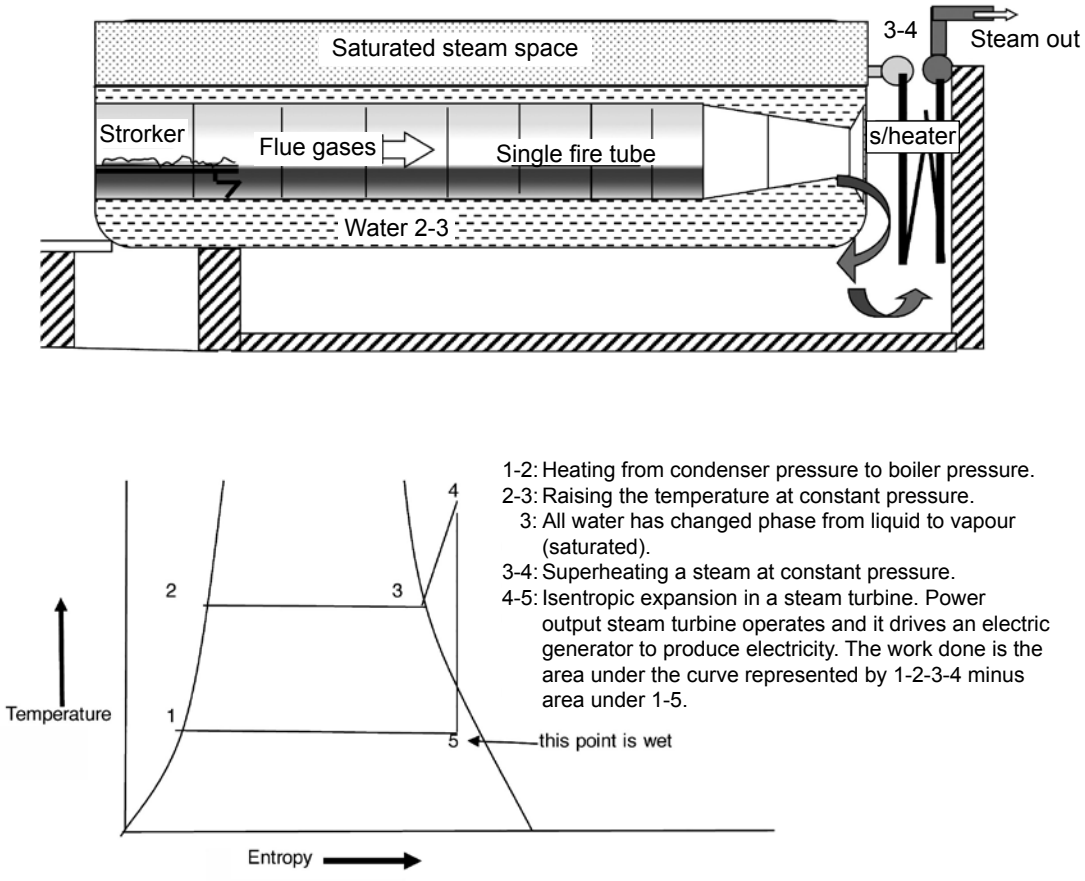

Figure 1. A Lancashire boiler and temperature-entropy chart.

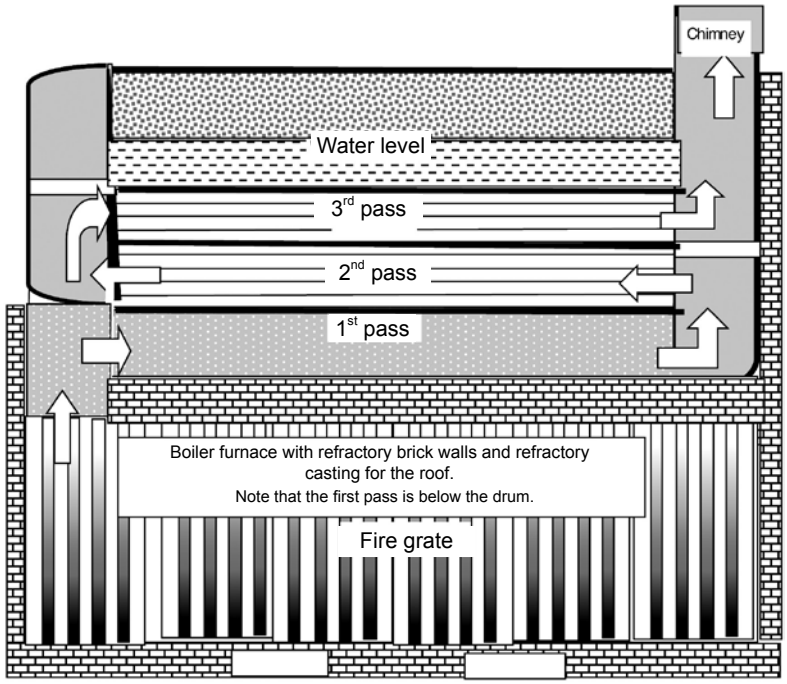

Figure 2. Stork three-pass fire tube boiler.

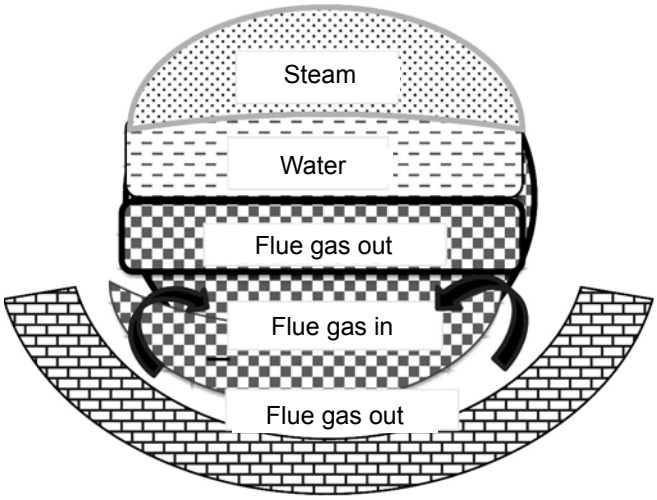

Figure 3. The flue gas path.

Another significant difference between power station and palm oil mill boilers is the feed water treatment. Power stations use water which is demineralised before it is pumped into the boiler. This is a very useful operation as the life cycles of a boiler is directly related to the care given to purify the feed water. Demineralised water is purer than distilled water as it does not carry any traces of minerals that could otherwise cause deposition within boiler tubes leading to scale formation.

It is rather a mystery that palm oil mill management in Malaysia is quite contented with the simple raw water treatment system comprising water clarification using flocculation tank, followed by sand filtration and water softening. This is indeed a far cry from the highly effective demineralisation plant (usually called demin plant) which is popular in Indonesian mills. It is far more critical for palm oil mill boiler feed water to be demineralised as the water circuit is an open one and the quality of the muddy raw water drawn from the stream is far from satisfactory. The reason why the power station boilers last nearly half a century is basically because of the care taken to treat the boiler feed water. If the palm oil mill boilers are fed with demineralised water, its life span can be extended considerably especially when palm oil mills are opting for high pressure boilers exceeding 20 bar.

WATER TUBE BOILERS

Water tube boilers (*Figure 4*) made its debut in Malaysia when the oil palm cultivation started expanding by leaps and bounds mainly after 1970s. Until now the palm oil industry had mainly focussed on processing the crop to produce crude palm oil (CPO) and palm kernel (PK). But now time has come to widen the scope of the industry by paying attention to other products like power generation within the mill that could host a number of unrelated industries in the surrounding areas as power at a cheaper price may become available. This could give rise to assorted generation of custom made boilers and turbines to cater for these specific requirements. Overnight the industry may take on a different path.

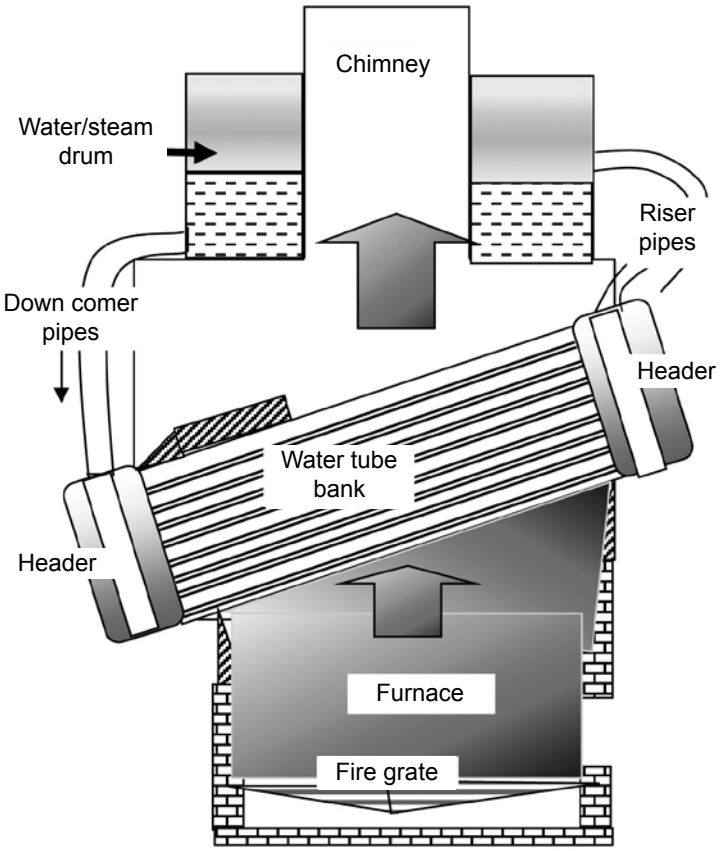

Figure 4. A vertical frazer water tube boiler.

The boilers will have to shed the current attachment to the inefficient boilers and turbines and start growing big. There are innumerable options when considering water tube boilers. It can have very high capacities and ratings in terms of pressure and temperatures.