Everyman's Guide to Good Boiler Combustion

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The oil palm mill boiler has been a source of both pride and disgust over the history of the palm oil industry in Malaysia. Pride is usually restricted to the first two years of a new boiler, then slowly turning to dissent as the chimney smoke change to black and maintenance issues creep in.

After the initial euphoria, "reality" kicks in and we all know the common phrases that replace any pride we had:

- Palm Oil Industry is like that: The fuel can never be consistent
- Sometimes we have to feed wet shells because of a plant break-down
- The fuel spread can never be perfect

Of course, the above-mentioned "realities" are real issues in a palm oil mill and boiler operation, but the irony is that they are used as excuses not to operate the boiler with modern control systems. The fact is, modern control systems will make a much bigger difference with such limitations than they will make with a homogenous fuel boiler like fuel oil or gas.

Let us look at the basic controls a boiler should have:

1. Fuel feed based on steam pressure through a PID Loop (Control Loop 1)

Don't worry this is the everyman's guide, lets briefly explain: The controller compares the steam pressure at the moment with the desired steam pressure. If the error is close to zero, it will remain with the current signal to the fuel feeders. If the error is large, it will speed up or speed down proportionate to the error. This is the P in PID. The integral is the error over time. If the error now is higher than the error before, the signal must be increased because the controller is not responding fast enough. That is the integral and the "I" in the PID. The D is for the error of the error and is usually not used.

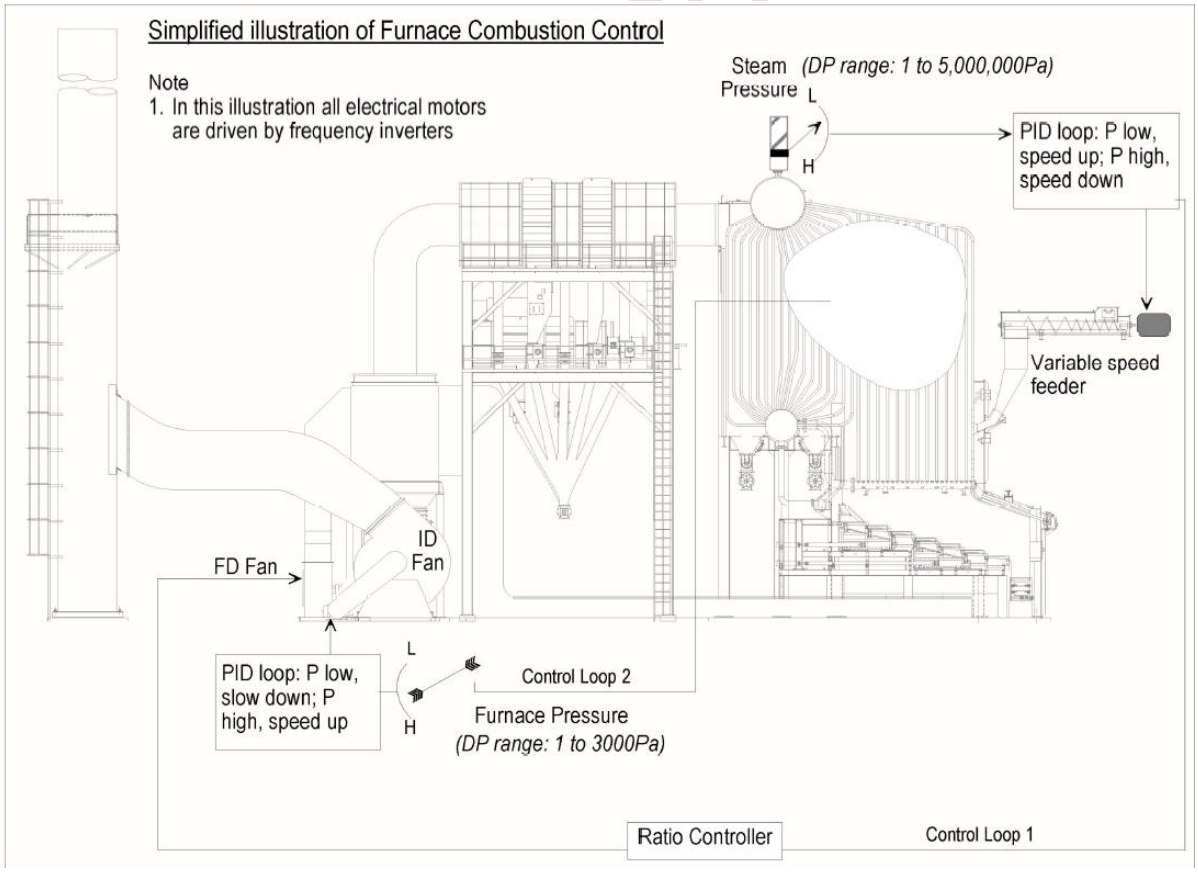
2. While the fuel feed responds to the steam pressure (or steam demand), the

combustion air needs to be adjusted (Control Loop 1)

This is called air/fuel ratio control. The rule is more fuel, more air, and vice versa. Now before you want to argue about heaps in the furnace or any other excuses. Give your boiler a chance and start with the basics. No fuel, no air, more fuel more air, and your furnace may just surprise you in limiting fuel build-up and clinker formation.

3. Furnace Draft Controller (Control Loop 2)

LEAVE THE FURNACE DRAFT FOR THE ID FAN ONLY. Get rid of the confusion of how to "Balance" your furnace draft. That is the purpose of having an ID fan. It is not to work together with the Force Draft (FD) and Secondary air fans. The ID fan is a lone ranger that is there to give the fire the illusion of a natural draft whilst compensating for pressure losses due to the dust collector, pre-heat and economisers, and any other pressure-losing equipment you may have in the flue.



So, we now assume we have our three basic controls in place. Here is how it helps in our combustion:

Feeding the fuel based on a PID loop should stabilize the fuel feeders to a certain speed for a certain steam flow. If this is not achieved, and the fuel feeders keep on running from zero to maximum speed during operation, we change the PID settings and look at the air-fuel ratio.

The air-fuel ratio for a typical palm oil mill boiler should be around five (five kg of air for every kg of wet fuel).

This should give an excess air amount of 60% and an oxygen percentage of around 6% (volume %, wet) in the stack.

With this kind of air/fuel ratio, the furnace temperature will be high enough for stable combustion and the built-up of fuel and clinker formation will be limited. It will also help in stabilizing our fuel feeder's PID loop.

For your information, most biomass boilers are designed for 60% excess air in Malaysia. So, if you are not having low oxygen values (or more than 12% CO_2 by volume, dry), you are having too much excess air.

Lastly, take some time to look at the furnace draft controller. Somehow, most men (sorry guys, I write from experience only) have this idea that in order to get more heat out of the boiler, they need to whack more air through it. It is not an outside fire! This is a combustion system. **Your increased air may give you the temporary illusion of more heat, but what you actually are doing is cooling down the boiler, and limiting boiler output**. Maybe we can learn from women here, a soft approach is much more effective than trying to bulldoze the boiler into submission.

So next time you have your annual boiler shut-down, request your boiler service provider for an independent furnace draft controller linked to the furnace pressure sensor and ID fan inverter or control damper.

Make sure that you have a ratio controller installed that is based on the fuel feeder speed, and if you still do not have a variable-speed fuel feeder, invest in one, it's the the only way forward.