BioC - MILL MODEL

Title: example (15% moisture in fuel)

Input parameters

Fuel	=	wood
Total moisture in the fuel	=	15.00 %
Inherent moisture	=	0.50 %
Fuel temperature in inlet	=	15.00 °C
Outlet air temperature	=	70.00 °C
Min throughput	=	10.00 t/h
Max throughput	=	20.00 t/h
A/F at min throughput	=	2.10 kg air/kg fuel
A/F at max throughput	=	2.10 kg air/kg fuel
Seal air flow	=	0.50 kg/s
Grinding power	=	6.31 kWh/t
Grinding power to heat	=	80.00 %
Mill body area	=	100.00 m^3
Mill body thickness	=	200.00 mm
Ambient temperature	=	8.00 C
Ambient relative humidity	=	95.00 %
Atmospheric pressure	=	101.33 kPa
Seal air inlet temperature	=	20.00 °C

The moisture in the fuel will evaporate and transfer to the air when the fuel dries. The water content in the air will depending on the A/F ratio and throughput be: 7.58 - 7.55 %

The dew point in the ambient air is: 7.25 °C

The dew point in the outlet air is: 50.29 °C

The density of the air/steam mixture will be: 1.24 - 1.24 kg/m^3 at 0 °C and 1atm and 0.99 - 0.99 kg/m^3 at 70.00 °C

MASS BALANCE AT MAX THROUGHPUT

INPUT		
Dry fuel flow	=	4.72 kg/s
Fuel moisture flow	=	0.83 kg/s
Dry air	=	12.09 kg/s
Moisture in air	=	0.07 kg/s
Total	=	17.72 kg/s

OUTPUT		
Dry fuel flow	=	4.72 kg/s
Fuel moisture flow	=	0.03 kg/s
Dry air	=	12.09 kg/s
Moisture in air	=	0.88 kg/s
Total	=	17.73 kg/s

HEAT BALANCE AT MAX THROUGHPUT

OUT

Air out	=	904.43 kW
Fuel out	=	427.98 kW
Heat in fuel moisture	=	8.14 kW
Heat in air moisture	=	2132.49 kW
Heat loss	=	163.00 kW
Total	=	3636.04 kW

air	24.87 %
fuel	11.77 %
moisture in air	58.65 %
moisture in fuel	0.22 %
loss	4.48 %
Total	100.00 %

IN

Heat from grinding	=	100.98 kW
Fuel in (dry)	=	88.97 kW
Moisture in fuel	=	52.40 KW
Seal air	=	10.82 KW
Moisture in seal air	=	0.12 KW
Heat air in	=	3346.43 KW
Heat air moisture in	=	36.32 KW
Total	=	3636.04 kW

Mill inlet air temperature = 267.20 °C

Motor_power	=	2.78 %
Heat_fuel_in	=	3.89 %
Heat_seal_air	=	0.30 %
Heat_air_in	=	93.03 %

The calculations below doesn't currently take fuel moisture into account so might give misleading results at high moisture content

ONE MILL OFFTAKE PIPE
Volumetric flow = 5.67 - 11.34 m^3/s
Maximum pipe diameter for stable flow at maximum throughput = 730.81 mm at 70.00 °C outlet temperature

Transport velocity at max pipe diameter = 13.51 - 27.02 m/s

AFTER BIFURCATION
Volumetric flow = 2.83 - 5.67 m^3/s
Maximum pipe diameter for stable flow at maximum throughput = 542.83 mm at 70.00 °C outlet temperature

Transport velocity at max pipe diameter = 12.25 - 24.49 m/s

AFTER TRIFURCATION
Volumetric flow = 1.89 - 3.78 m^3/s
Maximum pipe diameter for stable flow at maximum throughput = 456.16 mm at 70.00 °C outlet temperature

Transport velocity at max pipe diameter = 11.56 - 23.12 m/s

The Sankey diagram below show the percentual distribution of heat in and heat out through the different mass flows to and from the mill.