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	$= 100.00 \text{ m}^3$
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/m³ at 0 °C and 1atm and 0.99 - 0.99 kg/m³ at 70.00 °C

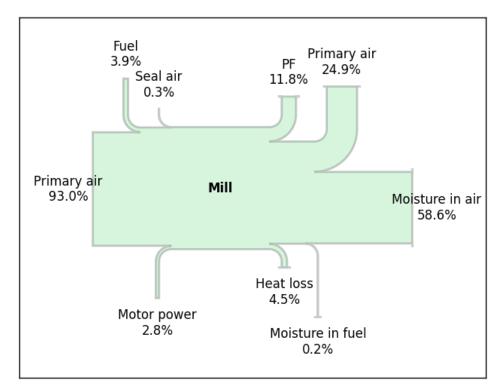
MASS BALANCE AT MAX THROUGHPUT INPUT Dry fuel flow = 4.72 kg/s Fuel moisture flow = 0.83 kg/s = 12.09 kg/s Dry air Moisture in air = 0.07 kg/s-----Total = 17.72 kg/s OUTPUT Dry fuel flow = 4.72 kg/s Fuel moisture flow = 0.03 kg/s Dry air = 12.09 kg/s Moisture in air = 0.88 kg/s _____ Total = 17.73 kg/s

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 -----= 3636.04 kW Total 24.87 % air 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 Seal air = 52.40 KW = 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 = $5.67 - 11.34 \text{ m}^3/\text{s}$ 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 = $2.83 - 5.67 \text{ m}^3/\text{s}$ Maximum pipe diameter for stable flow at maximum throughput = 542.83 mm at 70.00 °C outlet temperature

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Transport velocity at max pipe diameter = 12.25 - 24.49 m/s
AFTER TRIFURCATION
Volumetric flow = 1.89 - 3.78 m<sup>3</sup>/s
Maximum pipe diameter for stable flow at maximum throughput = 456.16
mm at 70.00 °C outlet temperature
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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.



Heat balance example (15% moisture in fuel)