The Sugar Engineers

Mill and Trash Plate Setting

The Sugar Engineers can offer an effective and rapid mill setting service for your factory. In order to get a sense of what we can offer you can do mill setting calculations online for your mill now.

Setting a mill includes the calculation of the openings between the various mill rolls and well as the shape and position of the trashplate. The work openings are calculated first. The work openings are the gaps between the top roll and the feed roll on the one hand and the opening between the top roll and the discharge roll on the other, when the mill is in operation. The next step is to calculate the set openings, that is, what the gaps should be when the mill is empty. The positions of of the mill rolls and the trashplate are adjusted until the set openings are achieved.

Geometry of Mills

![Diagram of mill geometry](image)

**Tooth Profile**

![Diagram of tooth profile](image)

**Mill Geometry Parameters**

- Top roll mean diameter [mm] \(MD_T\)
- Discharge roll mean diameter [mm] \(MD_D\)
- Feed roll mean diameter [mm] \(MD_F\)
- Tooth Pitch [mm] \(TP\)
- Tooth Flat [mm] \(T_f\)
- Tooth Angle [°] \(T_{ang}\)
- Tooth Depth [mm] \(T_{depth} = (TP - T_f) / (2 \cdot \tan(T_{ang} / 2))\)
**Roll Length [mm] \( l \)**
- Vertical distance between top and side roll centres at rest [mm] \( V_{rest} \)

### Mill Operating Parameters
- **Cane throughput [ton cane/h] \( t_{ch} \)**
- **Fibre content of cane as a percentage \( f\%c \)**
- **Mill lift [mm] \( l \)**
- **Fibre throughput [kg/min] \( \text{fibre throughput} \)**
- **Fibre fill in the discharge opening [kg/m\(^3\)] \( ff_{D} \)**
- **Speed of top roll [rpm] \( n \)**
- **Ratio of feed opening to discharge opening in the working position \( \text{millratio} \)**

### Calculations
- **Average peripheral velocity of top/feed rolls [mm/min]** \( V_{TF} = 2 \cdot \pi \cdot n \cdot 0.5 \cdot (MD_{T} + MD_{F}) / 2 \)
- **Average peripheral velocity of top/discharge rolls [mm/min]** \( V_{TD} = 2 \cdot \pi \cdot n \cdot 0.5 \cdot (MD_{T} + MD_{D}) / 2 \)
- **Escribed volume in the discharge opening \( [m^3/\text{min}] \)** \( v_{EscrD} = \text{fibre throughput} / ff_{D} \)
- **Discharge Work opening \( [mm] \)** \( w_{D} = v_{EscrD} \cdot (V_{TD} - l_{roll}) / 1000 \)
- **Escribed volume in the feed opening \( [m^3/\text{min}] \)** \( v_{EscrF} = \text{fibre throughput} / ff_{F} \)
- **Feed Work opening \( [mm] \)** \( w_{F} = v_{EscrF} \cdot (V_{TF} - l_{roll}) / 1000 \)
- **Top - Feed roll Centres (Working) [mm]** \( TF = MD_{T} / 2 + MD_{F} / 2 + w_{F} \)
- **Top - Discharge roll Centres (Working) [mm]** \( TD = MD_{T} / 2 + MD_{D} / 2 + w_{D} \)
- **Horizontal distance between top roll and feed roll centres [mm]** \( HF = \sqrt{(TF^2 - (V_{rest} + l)^2)} \)
- **Horizontal distance between top roll and discharge roll centres [mm]** \( HD = \sqrt{(TD^2 - (V_{rest} + l)^2)} \)
- **Set feed opening (Tip to Bottom) [mm]** \( so_{F} = \sqrt{(HF^2 + V_{rest}^2)} - MD_{T} / 2 + MD_{F} / 2 \)
- **Set discharge opening (Tip to Bottom) [mm]** \( so_{D} = \sqrt{(HD^2 + V_{rest}^2)} - MD_{T} / 2 + MD_{D} / 2 \)

### Trash Plate Settings
- There are a number of methods of setting out a trashplate for a mill, these are discussed by Hugot, *Handbook of Cane Sugar Engineering*, Jenkins, *Introduction to Cane Sugar Technology*, 1966 and Maxwell, *Modern Milling of Sugar Cane*, 1932. In addition a number of papers discussing this topic have been published among them Ashe, GG, *SASTA*, 1963 and Van Hengel, A and Douwes Dekker, K, *SASTA*, 1958.

Each factory that I have knowledge of has their own idiosyncratic method of laying out a trashplate, but when analysed all these methods amount to much the same thing. Hugot notes that the ideal shape of a trashplate is the logarithmic spiral, and points out that the simplest approximation to this is an arc whose center is offset from the centre point (in the working position) of the top roll along a horizontal line towards the discharge roll. The logarithmic spiral can be calculated in a spreadsheet and then set out in a cad drawing, the approximate arc can then fitted to the logarithmic spiral.