LIMESTONE MILL OPTIMIZATION
EQUATION SEQUENCE

Get values of design vars. from optimization

D, V, d

Compute Slurry Flow rate

$$Q = \frac{1}{4}\pi D^2 V$$

Compute Flow Rate of Limestone

$$Q_l = W/\gamma$$

Compute Flow Rate of water

$$Q_w = Q - Q_l$$

Compute Slurry Concentration

$$c = Q_l/Q$$

Compute Slurry density

$$\rho = \rho_w + c(\gamma - \rho_w)$$

Compute Power for Grinding

$$P_g = 218 W \left(\frac{1}{\sqrt{d}} - \frac{1}{\sqrt{a}}\right)$$

Compute R_w

$$R_w = \frac{\rho_w V D}{\mu}$$

Compute f_w

$f_w = 0.3164 / R_w^{0.25}$ if $R_w \le 10e^5$

$f_w = 0.0032 + 0.221 R_w^{-0.237}$ if $R_w \ge 10e^5$

Compute $C_d R_p^2$

$$C_d R_p^2 = \frac{4 g \rho_w d^3 (\gamma - \rho_w)}{3\mu^2}$$

Compute f

$$f = f_w\left(\frac{\rho_w}{\rho} + 150 c \frac{\rho_w}{\rho}\left(\frac{g D (s-1)}{V^2 \sqrt{C_d}}\right)^{1.5}\right)$$

Compute ΔP

$$\Delta P = \frac{f \rho L V^2}{2 D g_c}$$

Compute Power for Pumping

$$P_f = \Delta P Q$$

Compute Initial Cost

$$cost\_initial = 300\left(P_g/550\right) + 200\left(P_f/550\right)$$

Compute Yearly Operating Cost

$$cost\_yearly = 0.07\left(\frac{P_g}{550}\right) 8 * 300 + 0.05\left(\frac{P_f}{550}\right) 8 * 300$$

Compute Net Present Value for Operating Costs

$$P_{cost} = cost\_yearly \frac{(1+i)^n - 1}{i(1+i)^n}$$

Compute Total Cost

$$cost\_total = cost\_initial + P_{cost}$$

Compute V_c (for constraint)

$$V_c = \left(\frac{40 g c (S-1) D}{\sqrt{C_d}}\right)^{1/2}$$

Loop until optimum found