

COMPUTER PROGRAM LISTING FOR THE BUFFELSFONTEIN
 INCORPORATING A 5 SUB-MILLS PEBBLE MILL POWER

108
 CIRCUIT
 MODEL.
 (cont'd.)

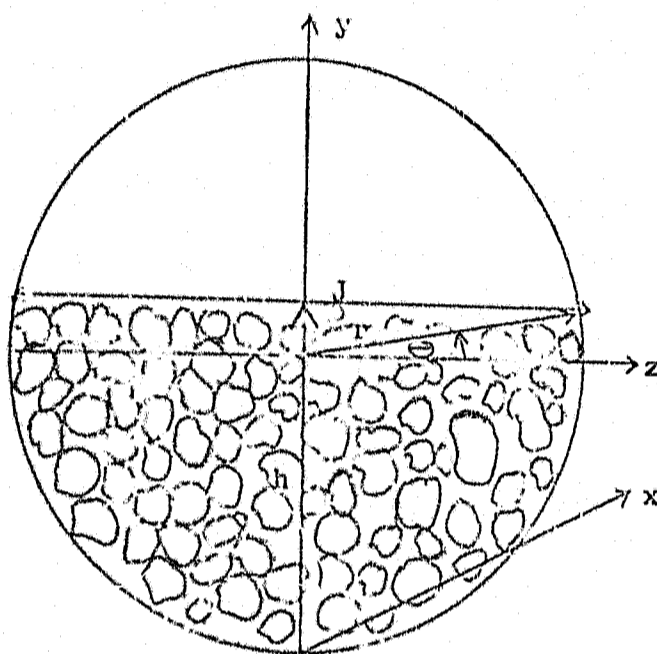
```

L.0548 GO TO 46
L.0549 46 CONTINUE
L.0550 36 YESNO6=0.0
L.0591 46 CONTINUE
L.0592 SORT
L.0593
L.0594
L.0595
L.0596
L.0597
L.0598
L.0599
L.0600
L.0601
L.0602
L.0603
L.0604 /*
    TIMER FINTIME=1.7, OUTDFL=0.02
    PRTPLT PRODS(PCW01, X1A, Y2A)
    PRTPLT CIRCLD(WHASA1, WNASB1, MMASC1)
    PRTPLT X3A(Y4, X5, X6)
    PRTPLT X7(YE SNO1, VPWER2, MPWER3)
    PRTPLT MPWER4(YE SNO4, YF SNO2, YESNO3)
    PRTPLT S1(S2, S3, S4)
    PRTPLT X7(X8, X9, X10)
    END
    STPR
    ENDJOB
    
```

15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63

APPENDIX 2

THE EXTENSION OF THE DISCRETE SUB-MILLS CONCEPT FOR
THE PEBBLE MILL TO AN INFINITE NUMBER OF SUB-MILLS



In section 4.4.4.1 it was shown that the flow of material down the length of the mill is given by:

$$\text{Flow} = (Z)(J)(dh/dx)$$

For a continuous system we can write:

$$\text{Flow}(x,t) = (Z)(J(x,t))\left(\frac{\partial h(x,t)}{\partial x}\right)$$

where:

$h(x,t)$ = height of the mill charge at point x along the mill and at time t

Z = a constant

$J(x,t)$ = width of the charge surface at point x along the mill and at time t

Assume that $J(x,t)$ is a constant in the region of operation (i.e. where θ is small), and, since the sign of

dh/dx is negative, to ensure that the overall flow is positive the overall flow equation must be:

$$\text{Flow}(x,t) = -Z' \left(\frac{\partial h(x,t)}{\partial x} \right)$$

where:

$$Z' = (Z)(J(x,t))$$

now

$$\frac{\partial m(x,t)}{\partial t} = \frac{\partial \rho A(x,t) \Delta x}{\partial t} = \text{Flow}(x,t) - \text{Flow}(x + \Delta x, t) \dots \text{A2.0}$$

where:

$\frac{\partial m(x,t)}{\partial t}$ = rate of change of mass at a point x along the mill and at time t

A(x,t) = cross-sectional area of the charge at point x along the mill at time t

ρ = density of mill charge

A2.0 can be rewritten as:

$$\frac{\partial \rho A(x,t)}{\partial t} = \frac{\text{Flow}(x,t) - \text{Flow}(x + \Delta x, t)}{\Delta x}$$

or

$$\frac{\partial \rho A(x,t)}{\partial t} = - \frac{\partial \text{Flow}(x,t)}{\partial x} = \frac{\partial Z' \partial h(x,t)}{\partial x \partial x}$$

but J(x,t) has been assumed constant, therefore the above equation becomes:

$$\frac{\partial A(x,t)}{\partial t} = \frac{Z'}{\rho} \left(\frac{\partial^2 h(x,t)}{\partial x^2} \right) \dots \dots \dots \text{A2.1}$$

Assuming that $\sin \Theta = \Theta$ for values of Θ in the operating region, (see Appendix 3 for an error analysis of this),

it can be shown that:

$$h(x,t) = r + r\Theta(x,t) \dots \dots \dots \text{A2.2}$$

$$A(x,t) = \frac{1}{2} \pi r^2 + 2r^2 \Theta(x,t) \dots \dots \dots \text{A2.3}$$

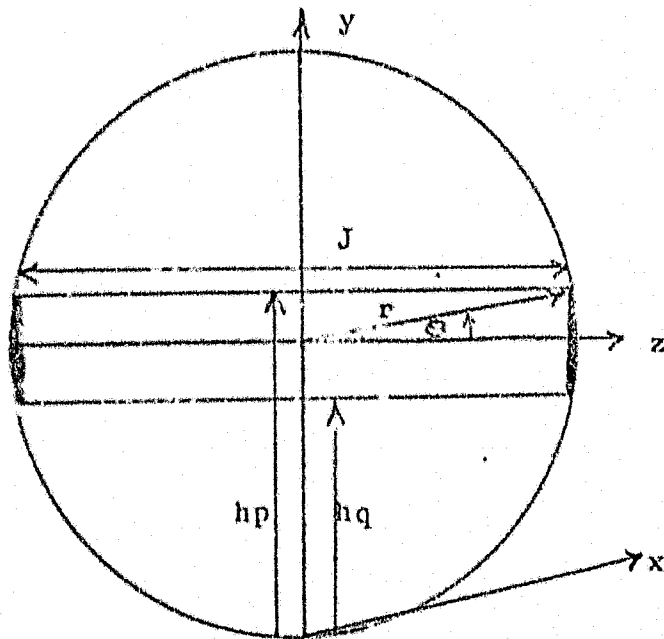
Substituting A2.2 and A2.3 in A2.1, the following equation results:

$$2r^2 \frac{\partial \Theta(x,t)}{\partial t} = \frac{Z' r \partial^2 \Theta(x,t)}{\rho \partial x^2}$$

APPENDIX 3

JUSTIFICATION OF ASSUMPTIONS USED IN DERIVATIONSAssumption 1:

$$\frac{J(h_p - h_q) = A_p - A_q}{\text{(For the mill approximately one half full)}}$$



Consider the above figure. The error of the assumption is due to the fact that the shaded regions are not included in the area calculation.

It can be shown that when the mill mass varies by 15% about the one half full point:

$$\frac{J}{J} = 0.993r \text{ (0.7\% error)}$$

Therefore, in this case, the maximum error in area will be 1.4%.

In the case of a 30% variation about the one half full

point:

$$\frac{J}{2} = 0.971r$$

resulting in a 6% error in area.

Assumption 2:

$\sin \theta = \theta$ in the operating region of the mill.

A 15% mill mass fluctuation means that θ is 6.8° .
This results in a 0.3% difference between θ and $\sin \theta$.

A 30% mill mass fluctuation means that θ is 13.8° .
This results in a 1% difference between θ and $\sin \theta$.

APPENDIX 4DERIVATION OF BULK DENSITY FUNCTION

$$\text{bulk density} = \frac{\text{total mass}}{\text{total volume occupied}}$$

$$\text{total mass} = MM + X_1 + X_2$$

$$\text{total volume occupied} \\ (\text{assuming 40\% voids}) = 1.4\left(\frac{MM}{W}\right)$$

therefore:

$$\text{bulk density} = \frac{W}{1.4} + \frac{W(X_1 + X_2)}{1.4(MM)}$$

APPENDIX 5

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