Washing of the filter cake

Two methods of washing can be employed :

i) Simple washing :

The wash liq. is fed in through the same channel as the slurry but , as it velocity near the point of entry is high , erosion of the cake takes place .

Rate of washing = Rate of filtration

$$\left(\frac{dV}{dt}\right)_w = \left(\frac{dV}{dt}\right)_f = \frac{A^2(\Delta p)}{r\mu v(V+V_e)}$$

ii) Through washing :

The wash water is introduced through a separate channel behind the filter cloth on alternate plates , known as washing plates , for example plate and frame filter were the washing liq. pass through the cake twice the thickness and the area only half as large as in the filtration therefore rate of washing is (1/4) rate of filtration .

Equations for washing of filter cakes and total cycle time :

In filters where the wash liq. follow the flow path , similar to that during filtration as in the leaf filters , the final filtering rate gives the predicted washing rate . For const. press. filtration using the same press. in washing as in filtering , the final filtering rate is the reciprocal

$$\left(\frac{dV}{dt}\right)_f = \frac{1}{K_f V_f + B}$$

Where :

$\left(\frac{dV}{dt}\right)_f$: rate of washing in (m^3/s) .

V_f : total vol. of filtrate for the entire period of the end of filtration (m^3) .

For plate and frame filter presses , in the wash liq. travels through a cake twice as the thick and an area only half as large as in filtering , so the predicted washing rate is (1/4) of the final filtration rate :

$$\left(\frac{dV}{dt}\right)_f = \frac{1}{4}.\frac{1}{K_f V_f + B}$$

Washing rate in a small plate and frame filter were found to be (70-92%) of that predicted . After washing is completed , additional time is needed to remove the cake clean the filter , and reassemble the filter . The total filter cycle time is the sum of filtration time , plus the washing time , plus the cleaning time .

$$\left(\frac{dV}{dt}\right)_w = \frac{1}{4}\left(\frac{dV}{dt}\right)_f = \frac{1}{4}\left[\frac{A^2(\Delta p)}{r\mu v(V+V_e)}\right]$$

Optimum time cycle (plate & frame)

The optimum thickness of cake to be formed in a filter press. depends on the resistance offered by the filter cake and on the time taken to disnatle and refit the press. for a filtration carried out at const. press.

$$\frac{t}{V} = \frac{r\mu v}{2A^2(\Delta p)}V + \frac{r\mu L_e}{A(\Delta p)} \quad \text{or} \quad \frac{t}{V} = \frac{r\mu v}{2A^2(\Delta p)}V + \frac{r\mu v}{A^2(\Delta p)}V_e$$

$$\frac{t}{V} = B_1 v + B_2$$

Where :

B_1 & B_2 are const.

Thus the time of filtration (t) is given by :

$$t = B_1V^2 + B_2V = t_f$$

Time required of one complete cycle (t_c)

t_c = t_f + (time of dismautle)+(time of assemble) + (time of removed of each from) + (time of washing)

overall rate of filtration

$$w = \frac{vol.of\ filtrate\ per\ cycle}{total\ time\ required}$$

$$w = \frac{V}{t_c} = \frac{V}{t_f+t'} = \frac{V}{B_1V^2+B_2V+t'}$$

W is max. when $\frac{dV}{dt}$ = zero

Differentiating w with respect to V and equating to zero

$$B_1V^2 + B_2V + t' - V(2B_1V + B_2) = 0 \quad , t' = B_1V^2$$

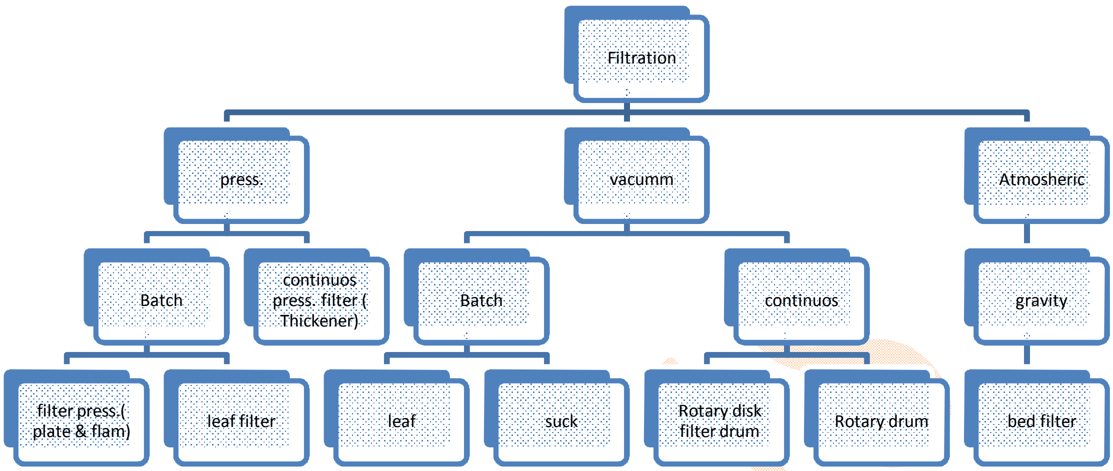
$$\therefore V = \sqrt{t'/B_1}$$

If the resistance of the filter medium is neglected

$$t = B_1V^2$$

Classification of filtration Equipment

1- Filters operate with press. above atmospheric on the up-stream side of the filter medium .
2- Filter operate with atmospheric press. on the upstream .
3- Filters operate with vacuum on the downstream .


Filtration
press.
vacumm
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