<http://www.cemnet.com/forum/Section/Technical-Cement-Forum>

<http://www.cemnet.com/Forum/thread/150906>

Both sets of equations are indeed related and are both correct in their own context. The equations I gave can be used if the mass flows of all streams into and out of the screen as well as the oversize and undersize fractions are known. Chari's equations can be used when the mass flows are not known and you only have the mass fractions of undersize and oversize in each stream. Also Chari's example does not use the data initially provided by Raj, so it was never meant to give the same answer.

I can show you how the two sets of equations are derived from each other and also that when Raj's original data is used in Chari's equations we both get the same answer;-

If, as before, we define the screen system variables as;-

Qms(f) = Mass flow rate of solid feed to screen.

Qms(o) = Mass flow rate of solid in the screen overflow.

Qms(u) = Mass flow rate of solid in the screen underflow.

Mu(f) = Mass fraction of undersize in the feed to screen.

Mo(f) = Mass fraction of oversize in the feed to screen.

Mu(o) = Mass fraction of undersize in the overflow.

Mo(o) = Mass fraction of oversize in the overflow.

Mu(u) = Mass fraction of undersize in the underflow.

Mo(u) = Mass fraction of oversize in the underflow.

... and the screen efficiencies based on the oversize (Eo) and undersize (E(u) as;-

Qms(o) \* [1 - Mu(o)]

Eo = ----------------------------- { Equation 1}

Qms(f) \* [1 - Mu(f)]

Qms(u) \* Mu(u)

Eu = -------------------------- { Equation 2 }

Qms(f) \* Mu(f)

... and the overall screen efficiency as;-

E = Eo \* Eu { Equation 3 }

... then, substituting values from Equations 1 and 2 into Equation 3 we get;-

Qms(o) \* [1 - Mu(o)] Qms(u) \* Mu(u)

E = ----------------------------- \* ------------------------- { Equation 4 }

Qms(f) \* [1 - Mu(f)] Qms(f) \* Mu(f)

This equation contains both flow rate values and mass fraction values so, if we wish to have the overall screen efficiency in terms of mass fractions alone we need to obtain the

Qms(o) Qms(u)

values of ------------ and ------------ in terms of the mass fractions Mu(f), Mu(u) and Mu(o).

Qms(f) Qms(f)

So, considering the mass balance of the screening system, we can say that the mass flow rate of feed entering the screen must be equal to the oversize flow rate plus the undersize flow rate. ie;-

Qms(f) = Qms(o) + Qms(u) { Equation 5 }

Which can be written as either;-

Qms(u) = Qms(f) - Qms(o) { Equation 6 }

or ;-

Qms(o) = Qms(f) - Qms(u) { Equation 7 }

We can also write the mass balance in Equation 5 in terms of the mass fractions of each of the input and output streams. ie;-

Mu(f) \* Qms(f) = Mu(o) \* Qms(o) + Mu(u) \* Qms(u) { Equation 8 }

Now, substituting the value of Qms(u) from Equation 6 into Equation 8 , followed by a step-wise sequence of simplification, we have;-

Mu(f) \* Qms(f) = Mu(o) \* Qms(o) + Mu(u) \* [Qms(f) - Qms(o)]

Mu(f) \* Qms(f) = Mu(o) \* Qms(o) + Mu(u) \* Qms(f) - Mu(u) \* Qms(o)

Mu(o) \* Qms(o) - Mu(u) \* Qms(o) = Mu(f) \* Qms(f) - Mu(u) \* Qms(f)

Qms(o) \* [ Mu(o) - Mu(u) ] = Qms(f) \* [Mu(f) - Mu(u) ]

Qms(o) [Mu(f) - Mu(u) ]

----------- = -------------------- { Equation 9 }

Qms(f) [ Mu(o) - Mu(u) ]

Similarly by substituting the value of Qms(o) from Equation 7 into Equation 8 via the same simplification sequence we get;-

Qms(u) [Mu(o) - Mu(f) ]

----------- = -------------------- { Equation 10 }

Qms(f) [ Mu(o) - Mu(u) ]

Equations 9 and 10 can now be substituted into Equation 4 and simplified as below ;-

[Mu(f) - Mu(u) ] \* [1 - Mu(o)] [Mu(o) - Mu(f) ] \* Mu(u)

E = -------------------------------------- \* -----------------------------------

[ Mu(o) - Mu(u) ] \* [1 - Mu(f)] [ Mu(o) - Mu(u) ] \* Mu(f)

which is equivalent to...

[Mu(f) - Mu(u) ] [1 - Mu(o)] [Mu(o) - Mu(f) ] Mu(u)

E = ---------------------- \* ---------------- \* ---------------------- \* ---------- { Equation 11}

[ Mu(o) - Mu(u) ] [1 - Mu(f)] [ Mu(o) - Mu(u) ] Mu(f)

As you can see, Equation 11 is essentially the same as the one given by Chari, except that his variables A, B and C are equivalent to my variables Mu(f), Mu(u) and Mu(o) respectively.

So now, using Raj's original values of;-

Mu(f) = 0.2247 (calculated in my previous post)

Mu(u) = 0.94

Mu(o) = 0.08

...and substituting these values into Equation 11 we get;-

[ 0.2247 - 0.94 ] [ 1 - 0.08 ] [ 0.08 - 0.2247 ] 0.94

E = ---------------------- \* ------------------- \* ---------------------- \* ----------

[ 0.08 - 0.94 ] [ 1 - 0.2247 ] [ 0.08 - 0.94 ] 0.2247

-0.7153 0.92 -0.1447 0.94

= ------------- \* ------------- \* --------------- \* ----------

-0.86 0.7753 -0.86 0.2247

= 0.8317 \* 1.1866 \* 0.1683 \* 4.1833 = 0.696 or 69.5%

... which is the same overall efficiency as calculated in my previous post.

So you can see that the two sets of equations used by myself and Chari are basically the same thing, just expressed in different ways, and therefore give the same answers for the same inputs. Even so, Chari's answer is more correct in the context of this thread because Raj originally asked not only how to calculate the screen efficiency ,but also how to calculate it without knowing the input or output flow rates of the screen.... Equation 11 ( Chari's equation) does this nicely.

Hope this clarifies things for you.

Regards,

Ted.