⇒ TRAP EFFICIENCY [η_T].

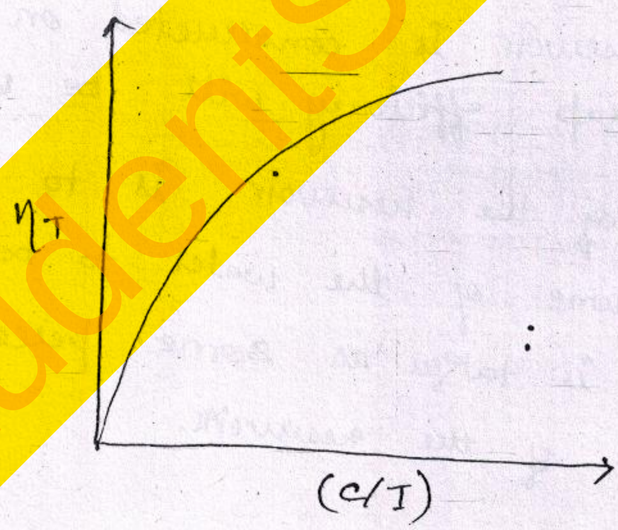
- It is defined as the %age of amount of silt settled in the reservoir to the total amount of silt present in the water.

$$\eta_T = \frac{\text{Amt. of silt deposited in the Reservoir}}{\text{" " " present " " water}} \times 100$$

Generally η_T = 90 to 95%.

- The trap efficiency depends upon the ratio of capacity of Reservoir to the inflow in the reservoir.

$$\eta_T = f^n\left(\frac{\text{capacity}}{\text{inflow}}\right)$$



Imp

→ With increase in life of reservoir, there is an increase in total amount of Sedimentation in the reservoir. But the rate of sedimentation decreases with increases inlife.

→ In the intial stages, capacity of the reservoir is more, and hence more amount of sediments settle in the reservoir.

↳ i.e:-

$C\uparrow$

$\frac{C}{I}\uparrow \longrightarrow \eta_T\uparrow$

$C\downarrow$

$\frac{C}{I}\downarrow \longrightarrow \eta_T\downarrow$.

→ In the final stages of the reservoir, its capacity decreases, (due to sedimentation) leading to decrease in rate of settlement of the sediments.

→ If a large reservoir is constructed on a small stream, its trap efficiency will be more.

i.e - $C\uparrow$; $I\downarrow \Rightarrow \frac{C}{I}\uparrow$ so $\eta_T\uparrow$.

→ if a small reservoir is constructed on a large stream, its trap efficiency will be very less.

→ if the life of the reservoir is to be calculated than the volume of the water to be occupied by the silt is taken as some percentage of intial volume of the reservoir.

Q/ A proposed reservoir has a capacity of 500 hac-m. The catchment area is 125 Km². And the annual streamflow is 12 cm. If the annual sediment production is 0.03 hac-m/Km². What is the probable life of reservoir before its capacity is reduced by 10% of its intial capacity by sedimentation.

The relationship b/w trap efficiency and $\left(\frac{C}{I}\right)$ is as follow also Calculate the life of the reservoir before 80% of its intial capacity is filled with sediments.

C/I	0.01	0.02	0.04	0.06	0.08	0.1	0.2	0.3
η_T	43	60	70	80	84	87	93	95

C/I	0.4	0.7
η_T	96	97

Soln
↳ Intial capacity = 500 hac
Inflow = 12 cm. in depth

↳ Inflow = $12 \times 10^{-2} \times 125 \times (10^3)^2 \times 10^{-4} = 1500$ hac-m.

→ sediment inflow = $\frac{0.03 \text{ hac-m}}{\text{Km}^2} \times 125 = 3.75$ hac-m

Intially

$$\left(\frac{C}{I}\right)_i = \frac{500}{1500} = 0.33$$

$$\eta_T = 0.02 + \frac{0.3 \times 1}{0.02}$$

$\eta_{Ti} = 95.15\%$

$$\left(\frac{C}{I}\right)_f = \left(-\frac{500\times10}{100} + 500\right)$$

⇒ Capacity of reservoir after 10% of the vol. is occupied by sedimentation.

$$= 500 - \frac{10}{100}\times 500 = 450 \text{ hacm.}$$

$$\left(\frac{C}{I}\right)_f = \frac{450}{1500} = 0.3.$$

$$(\eta_T)_f = 95\%.$$

Now, Avg Value of $\eta_T = \frac{95.15+95}{2}$

$$\eta_T = 95.075\%.$$

Rate of sedimentation $= \frac{3.75 \times 95.075}{100}$

$= 3.56$ hac-m.

life of the reservoir before 10% of its capacity

$$= \frac{50}{3.56} = 14.04 \text{ yers}$$

(ii) life to fill 1st 20% of intial capacity

$C = 500$ hac-m.

$$\left(\frac{C}{I}\right)_i = \frac{500}{1500} = 0.33; \ \eta_T = 95.15\%.$$

$$C_f = 500 - \frac{20}{100}(500) = 400 \text{ hac m.}$$

$$\left(\frac{C}{I}\right)_f = \frac{400}{1500} = 0.26 \ ; \ \eta_{Tf} = 94.20\%,$$

$$\eta_{T_{Avg}} = \frac{95.15 + 94.20}{} = 94.67\%.$$

– Rate of sedimentation: $3.75 \times \frac{94.75}{100} = \underline{3.55 \text{ hac-m/year}}$

life to fill 1st 20% of initial capacity is $= \frac{100}{3.55} = \underline{28.17 \text{ yrs.}}$ ~~28.16 yrs.~~

– Life to fill 2nd 20% of initial capacity.

$C_i = 400$ hac-m.

$\left(\frac{C}{I}\right)_i = \frac{400}{1500} = 0.26.$ $\eta_{Ti} = 94.2\%.$

$C_f = 400 - \frac{20}{100}(500) = 300$ hac-m.

$\left(\frac{C}{I}\right)_f = \frac{300}{1500} = 0.2$ $\eta_{Tf} = 93\%.$

$\eta_{T avg} = \frac{93 + 94.2}{2} = 93.6\%.$

Rate of sedimention $= 3.75 \times \frac{93.6}{100} = 3.51$ hac-m

life to fill 2nd 20% $= \frac{100}{3.51} = \underline{28.49 \text{ yrs}}$

→ life to fill 3rd 20% of Intial Capacity

$C_i = 300$ hac-m.

$\left(\frac{C}{I}\right)_i = \frac{300}{1500} = 0.2$ $\eta_{Ti} = 93\%.$

$C_f = 300 - \frac{20}{100}(500) = 200$ hac-m

$\left(\frac{C}{I}\right)_f = \frac{200}{1500} = 0.13$ $\eta_{Tf} = 88.98\%.$

$\eta_{T avg} = \frac{93 + 88.98}{2} = 90.99\%.$

Rate of sedimentation $= 3.75 \times \frac{90.99}{100} = 3.4$ hac-m.

~~Liff~~ life to fill 3rd 20% of IC = 29.32 yrs

⇒ Liff to fill 4rth 20% of Intial Capacity.

$C_i = 200$ hac-m.

$\left(\frac{C}{I}\right)_i = \frac{200}{1500} = 0.13$ $\eta_{Ti} = 88.98\%$.

$C_f = 200 - \frac{20}{100}(500) = 100$ hac-m

$\left(\frac{C}{I}\right)_f = \frac{100}{500} = 0.066$; $\eta_{Tf} = 81.4\%$.

$\eta_{T avg} = \frac{81.4 + 88.98}{2} = 85.19\%$.

Rate of sedimentation $= 3.75 \times \frac{85.19}{100} = 3.194$ hac-m

life of 4th 20% of Initial Capacity $= \frac{100}{3.194} = 31.3$ yrs.

Total life = 28.17 + 28.49 yrs + 29.32 + 31.3

= 117.35 yrs.