8. Filtration

- **Operation**

The conventional filtration is probably the most important single unit operation of all water treatment processes. It is an operation process to separate suspended matter from water by flowing it through porous filter medium or media. The filter media may be silica sand, anthracite coal, garnet, ilmenite, or finely woven fabric. Filter is very effective for removing flocs containing microorganisms such as algae, bacteria, and virus.

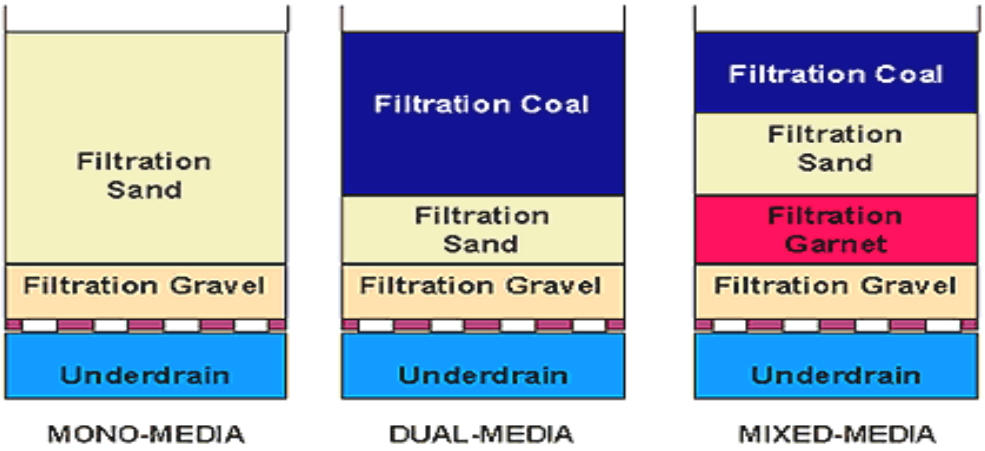

Fig.1: Filter medium and media

Over flow Loading rate (OFR) is the flow rate of water applied to the unit area of the filter. It is the same value as the flow velocity approaching the filter surface and can be determined by:

$$\mathbf{OFR = Q/A}$$

OFR= over flow loading rate. $m^3/m^2.d$ or gpm/ft^2, the typical OFR for rapid sand filter is 120 $m^3/m^2.d$.

Q= flow rate, m^3/d or ft^3/d or gpm

A= surface area of filter. m^2 or ft^2

Example (finding the number and surface area): A city is to install rapid sand filters downstream of clarifiers. The design loading rate is selected to be 160 $m^3/m^2.d$. The design capacity of the waterworks is 0.35 m^3/s. The maximum surface per filter is limited to 50 m^2. Design the number and size of filters and calculate the normal filtration rate.

Solution:

Step 1: Determine the total surface area required:

$$A = \frac{Q}{OFR} = \frac{0.35\ m^3/s}{160 \frac{m^3}{m^2.d}} = 189\ m^2$$

Step 2: determine the number (n) of filters

$$n = \frac{189\ m^2}{50\ m} = 3.78$$ Select four filters

The surface area (a) for each filter is

$$a = \frac{189}{4} = 47.25\ m^2$$

We can use 7 m x 7 m or 6 m x 8 m, or 5.9 m x 8 m (exact) المساحة الحقيقية

Step 3: if 7 m x 7 m filter is installed, the normal filtration rate is

$$OFR = \frac{Q}{A} = \frac{0.35 \frac{m^3}{s} x\ 86400\ \frac{s}{d}}{4\ x\ 7\ x\ 7} = 154.3\ \frac{m^3}{m^2.d}$$ هذا الحقيقي وليس160

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