APPLICATIONS OF ADSORPTION

2.7 ROLE OF ADSORBENTS

Activated carbon in pollution abatement

ACTIVATED CARBON IN POLLUTION ABATEMENT

Among the various adsorbents, in pollution abatement of air and waste water, activated carbon is the most commonly used adsorbent because it has a large surface area per unit weight (or) unit volume of solid.

Treatment of Polluted Water and Air

Polluted water and air can be treated by using the following two types of activated carbons.

1) Granular Activated Carbon (GAC)
2) Powdered Activated Carbon (PAC)

1. Using Granular Activated Carbon (GAC)

A fixed - bed activated-carbon contactors (column) is often used for contacting polluted water (or) air with GAC. It can be operated singly, in series (or) in paralle1. Several types of fixed-bed activated - carbon contactors are used in the treatment of polluted water (or) air, of which the followings are important.

1. Down flow fixed-bed carbon contactors.
2. Up flow fixed-bed carbon contactors.

(a) Down flow fixed-bed Carbon Contactors

Down flow fixed-bed carbon contactors usually consist of two (or) three columns operated in series(or) in parallel as shown.

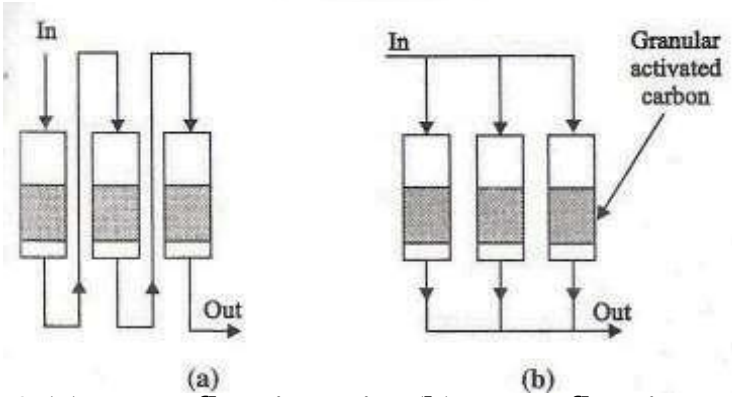

Figure 2.7.10 (a) Down flow in series (b) Down flow in parallel

[Source:https://www.bharathuniv.ac.in/colleges1/downloads/courseware_ece/notes/2%20BCH201%20%20-%20chemistry%202%20-%20NT.pdf]

The water (or) air is applied to the top of the column and withdrawn at the bottom. The activatedcarbon is held in place with an under drain system at the bottom of the column. Provision for back washing and surface washing is usually necessary to limit the headless build up due to the removal of particulate material within the carbon column.

Advantages

Adsorption of organic materials and filtration of suspended solids are accompanied in a single step.

Disadvantages

- Down flow filters may require more washing because of the accumulation material on thesurface of the contactor.
- Plugging of carbon pores may require premature removal of the carbon for regenerationthereby decreasing the useful life of the carbon.

(b) Up flow fixed-bed Carbon Contactors

In the up flow fixed-bed columns, the polluted water (or) air moves upward from the base of thecolumn as shown.

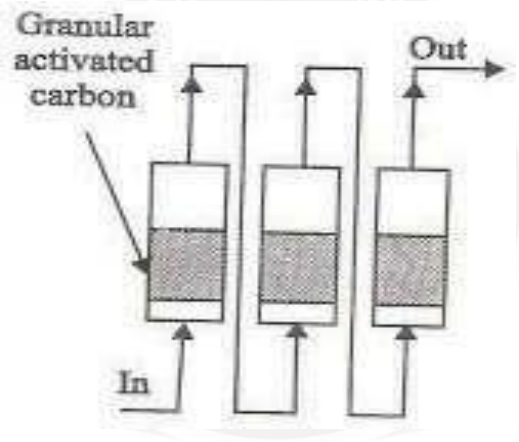

Figure 2.7.11 Up flow expanded in series

[Source:https://www.bharathuniv.ac.in/colleges1/downloads/courseware_ece/notes/2%20BCH201%20%20-%20chemistry%202%20-%20NT.pdf]

Advantages

As the carbon adsorbs organic materials, the apparent density of the carbon particles increases and encourages rnigration of the heavier or spent carbon downward.

Disadvantage

Up flow columns may have more carbon fines in the effluent than down flow columns, because up flow tends to expand, not compress, the carbon. Bed expansion allows the fines to escape through passage ways created by the expanded bed.

2. Using Powdered Activated Carbon (PAC)

In this method powdered activated carbon (PAC) is added directly into the effluent coming out from the various biological treatment processes.

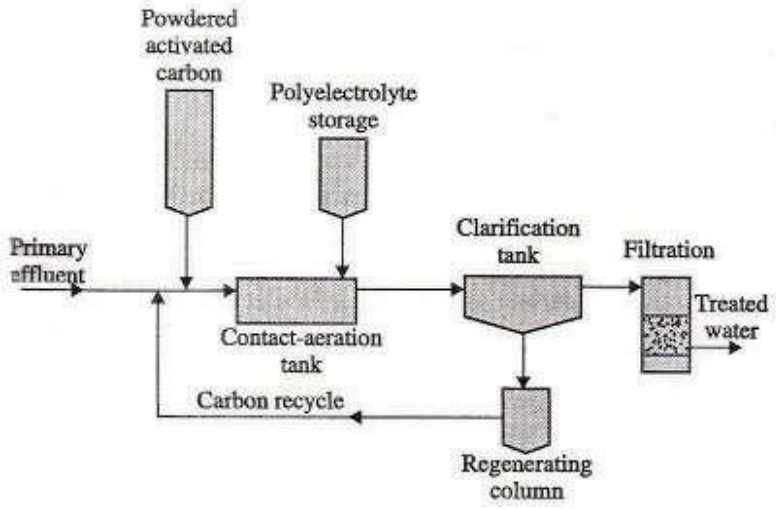

Figure 2.7.12 Flow diagram of activated-sludge process

[Source:https://www.bharathuniv.ac.in/colleges1/downloads/courseware_ece/notes/2%20BCH201%20%20-%20chemistry%202%20-%20NT.pdf]

The effluent, coming out from the biological treatment plant, is mixed with PAC and a coagulant(polyelectrolyte) in a contact-aeration tank. After some time, the effluent is allowed to store in a clarification tank, where the carbon particles get settled at the bottom of the tank Since the carbon particles are very fine, a coagulant such as polyelectrolyte is added to aid the removal of the carbon particles. The spent carbon is regenerated by passing it into the regenerating column and is used again for the process. Finally, the water (effluent) is filtered by passing it through the filtration column.