CARBON FILTERS

Activated carbon filters are used to absorb pollutants and gas effluents and remove odours in the air. They are made of mostly organic plant materials (coconut) in the form of granules and cylinders, of a sizing ranging from 3 to 5 mm, or flakes.

The filters are available in the following models:
- flat panels, with activated carbons held inside the frame of the filter panel by microdrawn grids.
- cartridges, made of two coaxial cylinders in microdrawn sheet containing activated carbons, installed on a metal sheet panel with bayonet fitting.
- compact V-shaped bags.
- V-shaped filter with high activated carbon content.
- The operation of the activated carbon filters is based on the adsorption process, meaning on the phenomenon of molecular diffusion between the components in gaseous phase and a solid substratum.

The gas molecules adhere to the surface of the solid and cause the formation of one or more overlapped layers of substance, created by the establishment of forces of electrostatic attraction (Van Der Waals forces) or of adhesive forces resulting from capillarity phenomena.
Since it is a phenomenon of molecular migration between a gaseous phase and a solid, a basic characteristic of the adsorbent material is the active surface that allows contact between the components. The very widespread presence of micro-porosity in the activated carbon permits an extremely extensive surface development.
The microscopic pores develop deep-down, gradually decreasing their section, and provide a surface development that can reach 1700 square metres per gram of material.
The adsorbent capacities of the activated carbons are particularly indicated for reducing organic compounds having a molecular weight between 50 and 200. Usually the compounds with a lower molecular weight are not sufficiently adsorbed due to their small dimensions. On the contrary, organic compounds that have high molecular weights are adsorbed so strongly that it is then extremely difficult to remove them during the regeneration phase.

Adsorption capacity is stated in percentage of weight or in kg of adsorbed organic contaminant per 100 kg of carbon used.

The capacity falls between the minimum values of 1% up to maximum values of 30%.
The capability to withhold the organic contaminants is influenced by a number of parameters, including temperature, humidity, pressure, the type and concentration of the pollutants, their molecular weight and the presence of particulate matter in the flow to be treated.
Retention of the organic contaminants is greater at lower temperatures and humidity.
This is why the activated carbon adsorbers usually operate at temperatures lower than 50° C and with relative humidity no higher than 70%.
Equally the higher is the air particulate the lower is the adsorption; for this reason the particulate should be normally removed by prefilters.
In all those applications where an high air pureness is needed, the terminal filter should be positioned downstream the carbon filter to avoid the room contamination with some carbon dust.
The filters selection is normally based on the air flow rate of the system or on an empiric method which states the activated carbon weight according to the room's volume and the type of application. The air velocity passing through the filters should be quite slow (0.25 m/s) to enable a correct operation. The panel filters' pressure drop according to this velocity value is about 50 Pa per cm of filter's thickness.
Active carbons can be regenerated by steam. The exhausted cells can be restored by granules' replacement. Carbon filters or alumina filters impregnated with chemical reagents are normally recommended to filter industrial processes gas (acid gas, formaldehyde, radioactive isotopes).

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Adsorption capacity of activated carbon filters

Very low	Low	Average	High		
1%	5%	10-15%	25-30%		
Acetylene	Acetaldehyde	Methyl acetate	Amyl acetate	Cyclohexane	Monochlorobenzene
Carbon dioxide	Hydrobromic acid	Acetone	Butyl acetate	Cyclohexanol	Nitroethane
Ethane	Hydrochloric acid	Hydrocyanic acid	Cellosolve acetate	Cyclohexanone	Nitromethane
Ethylene	Hydrofluoric acid	Formic acid	Ethyl acetate	Cycolhexene	Nitropropane
Hydrogen	Butane	Hydriodic acid	Sioropile acetate	Decane	Nitrotoluene
Methane	Butane	Nitric acid	Methylcellosolve acetate	Dibromomethane	Nonane
	Butene	Acrolein	Propyl acetate	Dichlorobenzene	Octane
	Dimethylacetylene	Methyl alcohol	Acetic acid	Dichloroethane	Mesityl oxide
	Formaldehyde	Ammonia	Acrylic acid	Dichloroethene	Ozone
	Sulphur dioxide	Sulphur trioxide	Butyric acid	Dichloroethyl ether	Pentanone
	Hydrogen selenate	Ethyl bromide	Lactic acid	Dichloronitroethane	Perchloroethylene
	Propane	Methyl bromide	Propionic acid	Dichloropropane	Propyl mercaptan
	Propylene	Butadiene	Sulphuric acid	Diethyl ketone	Ethyl silicate
		Chlorine	Ethyl acrylate	Dimethyl sulphate	Styrene monomer
		Ethyl chloride	Methyl acrylate	Dioxane	Turpentine
		Methyl chloride	Acrylonitrile	Dipropylacetone	Tetrachloroethane
		Vinyl chloride	Amyl alcohol	Essences	Tetrachloroethylene
		Dichlorodifluoromethane	Butyl alcohol	Amyl ether	Carbon tetrachloride
		Dichlorotetrafluoroethane	Ethyl alcohol	Butyl ether	Toluene
		Diethylamin	Isopropyl alcohol	Isopropyl ether	Toluidine
		Hexane	Propyl alcohol	Propyl ether	Trichloroethylene
		Hexene	Acetic anhydride	Ethylbenzene	Xilene
		Ethyl ether	Aniline	Ethyl mercaptan	
		Methyl ether	Benzene	Heptane	
		Ethylamine	Bromine	Heptene	
		Fluorotrichloromethane	Butyl Cellosolve	Phenol	
		Ethyl formate	Camphor	Iodium	
		Phosgene	Cellosolve	Iodoform	
		Freon	Chlorobenzene	Kerosene	
		Toxic gases	Chlorobutadiene	Menthol	
		Hydrogen sulphide	Chloroform	Mercaptan	
		Isoprene	Chloronitropropane	Methylbutylacetone	
		Ethylene oxide	Chloropicrin	Methyl Cellosolve	
		Pentane	Butyl chloride	Methylchloroform	
		Various solvents	Ethylene chloride	Methyl ethyl ketone	
		Carbon disulphide	Propylene chloride	Methylcyclohexane	
			Cresol	Methylcyclohexanol	
			Crotonaldehyde	Methylcyclohexanone	
				Mehyl mercaptan	

It is very difficult to exactly calculate the adsorption capacity of activated carbon in specific substance's components.
Our advice is to elaborate a spectrum classification.
By defining four adsorption classes it is possible to forecast the values in the above table (referred to weight).