CALGON CARBON CORPORATION

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Generic Loading and Unloading Procedures - in Liquid Applications

When we, CALGON CARBON, supplies Liquid Adsorbers like Model 10 or Amine Treatment System “CLEANAMIN”, we prepare a carbon inlet nozzle on the top shell and a carbon outlet nozzle on the bottom of an adsorber, which is equipped with an underdrain system using filter (screen) nozzles. In CLEANAMINE system, it is so easy to load/unload carbon by handling carbon-water slurry.

However, we would assume that your vessel is equipped with a carbon support grid of plate type and no nozzles for carbon inlet/outlet like ours. Instead, your adsorber may have an unloading nozzle (or a manway) on the side shell and a manway on the top. We guess these nozzles and/or manways may be used for carbon loading/unloading. We would recommend you to confirm this and the concept of carbon handling with the original designer, if you have no fixed idea.

We would describe generic loading and unloading procedures based on the above assumption. In addition, we would attach technical information titled “TRANSFER OF GRANULAR ACTIVATED CARBON TO AND FROM FILTERS”, provided by Chemviron, our European company. This is based on carbon transfer in water slurry. We believe this information will help you to load and unload carbon in water slurry.

Loading Procedure

1) You can use a manway to fill dry carbon from paper bags or supersacks. Open the top man way or loading nozzle (opening should be a minimum of 16" in diameter). You need a machine like a crane car to bring up paper bags or supersacks to the level of the top of adsorber.
2) If vessel has a top man way and vent nozzle, install a temporary funnel into the top man way. This funnel (from 16" to 29.5" (400 to 750 mm) in diameter) will avoid spillage and losses of the activated carbon. A coarse (approx. 20x20 millimeter opening) screen should be placed in the funnel to prevent large objects (tools, helmets, etc.) from falling into the adsorber during the transfer. If the point of fill cannot easily be reached, a chute can be fabricated to direct the carbon into the bed.
3) As an option, the top nozzle can be connected to the suction side of a blower to draw off fine carbon particles as the granules drop into the adsorber. This will keep the fine mesh carbon from entering the adsorber.

   Note: If this option is not chosen, some fine carbon dust will exit the top of the adsorber during filling. If this option is chosen and the carbon dust cannot be allowed to blow into the atmosphere, the blower discharge should be connected to an appropriate dust filter.
4) Before filling carbon, fill water up to 75 – 80% volume of filling GAC.
5) Chute carbon from the top manway into the adsorber.
   A) In the case of loading from 1,000 lb bulk bags or “supersacks”, place the bag over the manway or fill port by directing the crane, and pull drawstring to release the spout, which is located in the center of the bottom of the bag. A temporary or permanent working platform may be needed. If the supersacks are provided with liners as marked on the outside of the bag, take care not to allow the plastic liners and/or objects whatever except carbon to fall into the bed and become buried.
   B) In the case of loading from drums or paper bags, lift drums/paper bags of activated carbon to the top of the adsorber and dump the carbon directly from its container into the temporary funnel. A temporary or permanent working platform may be needed. It is also possible to pour several drums/paper bags into larger transfer bins at ground level and then lift the transfer bin to the top of the adsorber for loading into the vessel as above step 5A).
6) After you finish loading carbon completely, you need to backwash carbon in order to remove fine carbon and get the GAC bed segregated particularly in water applications, which require frequent backwashing. Approximately 30% bed expansion would be recommended for efficient fine removal and segregation.

Backwashing flow rate (m^3/h) can be obtained by multiplying the cross-sectional area (m^2) of the adsorber by required surface loading (LV, m/h). Data of backwashing LV vs. Bed Expansion (%) are shown in Table 1 for various carbon products. When you have no sufficient water supply source to backwash at desirable flow rate, you are requested to backwash the bed at 10% bed expansion at least just to remove fine carbon. Backwash water should be supplied upflow from a Nozzle for Outlet. Initial backwashing should be conducted with water of 4 - 6 bed volume or for 45 – 60 minutes. See “Backwashing” document for more information on Backwashing.

7) After backwashing, the GAC bed should be soaked with hot water for degassing from pores for at least one (1) day. The longer, the better. Three (3) day soaking would be recommended. This preparation is very important for the required performance.
8) Again backwash the bed to remove air from the bed. The bed should be expanded gradually up to 5 - 10% bed expansion. Two (2) bed volume of backwashing water should be required for the second backwashing.

Table 1. LV vs. Bed Expansion for Various Carbon Products

Product	**FS 400 CAL (12x40)**			**FS 300 SGL (8x30)**			**FS 816**			**FS 820**			**FS 100**			**FS 200**		
Temp (^oC)	25	30	35	25	30	35	25	30	35	25	30	35	25	30	35	25	30	35
LV (m/h) at																		
10% Exp’n	14	15	17	24	26	28	41	45	49	32	36	39	31	34	37	18	19	21
15% Exp’n	18	19	20	30	32	35	49	53	57	39	42	46	38	42	45	22	24	26
20% Exp’n	21	23	24	35	38	41	55	60	65	45	49	53	44	48	52	26	28	30
25% Exp’n	24	26	27	40	43	46	62	67	72	51	55	59	50	54	58	30	32	34
30% Exp’n	27	29	30	45	48	52	68	73	78	56	60	65	56	59	63	33	35	38

Unloading Procedure

Direct discharge from a Nozzle or Manway on the side shell

1) Stop the operation and depressurize the vessel.
2) Sweetening-off (Recovery of product)
   A) Supply hot water into the bed to recover product. Linear velocity should be about 1.2 m/H to displace the solution with water. It takes about several hours.
   B) Or, pressurize the vessel with air (nitrogen is much better for specific liquid like amine solution) to blow down the solution first and next supply hot water upflow to remove air bubbles with approximately 40 – 50% bed volume of carbon. Continue sweetening-off by a continuous method as above 2-A) or by a batch method.
   C) See "Sweetening-off" Document for more information.
3) Prepare a Trough or Chute for carbon discharge. (Width or diameter should be larger than the diameter of the discharging Nozzle/Manway, i.e. 20")
4) Place a destination container(s) on the ground to receive discharged carbon. A steel vessel or bin with dewatering screen(s), or a flexible bag of mesh-type (about 1 m^3 or greater) can be used as a destination container.
5) Open the blind flange of the discharging Nozzle/Manway little by little and pressurize the vessel with water or air/nitrogen to discharge carbon-water slurry by controlling discharge rate (or by controlling valve opening of feeding water or air/nitrogen). When air/nitrogen is used, additional water supply upflow will help carbon discharged smoothly.
6) In the last stage, the vessel should be backwashed at 5 to 10 % bed expansion to discharge carbon completely. It may be necessary for someone to enter the vessel to cleanup the vessel.
7) If ceramic or other inert balls were used in the adsorber as bed support or other reason, the ceramic balls should be removed with the spent carbon and disposed in a safe manner.
8) Inspect inlet and outlet nozzle for signs of debris and damage, inspect support screen, temperature indicators, probes & etc., and make any repairs necessary prior to re-loading the adsorber with fresh carbon.
9) If ceramic or other inert balls were used, install new inert balls in an adequate manner.
   After completion of unloading, all the blind flanges should be reconnected.

Vacuum Unloading from the top manway

This method is the cleanest and most efficient to minimize dust and spillage of spent carbon.

Generally, a contractor with a vacuum truck or an industrial cleaning company is hired. They provide all labor, material, equipment etc. necessary to complete the removal of the spent carbon and the installation of the fresh carbon. They usually remove the carbon using a vacuum truck from the top manway after sweetening-off the carbon bed and blowing-down the water as above Step 1) and 2) by your operators. Finally someone should enter the vessel to cleanup the vessel and to inspect the vessel as Step 8) above.