

PAC TO GAC

Converting PAC Users to Dynamic Adsorption with GAC



Introduction

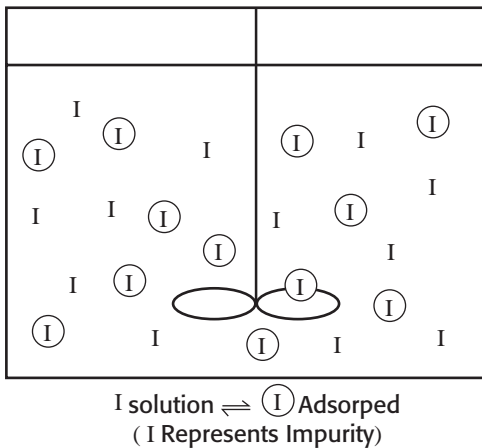
Activated carbon treatment of a liquid can be accomplished with an on-line dynamic adsorption system or with a batch process using powdered activated carbon (PAC). Dynamic adsorption uses either granular activated carbon (GAC) in a fixed bed adsorber or bonded carbon block cartridges. In certain liquid treatment applications, dynamic adsorption will outperform PAC and save the user time, money, and resources. Dynamic treatment with activated carbon may also allow the user to achieve a higher purity processed fluid.

Improved Carbon Utilization

Improved carbon utilization makes dynamic treatment more efficient and effective than PAC. To understand this, compare the adsorption characteristics of PAC to GAC.

PAC adsorption in a batch system results in an equilibrium between the impurity adsorbed on the carbon and the impurity remaining in the process fluid. This equilibrium occurs at a concentration which is lower than the initial concentration of the impurity (Figure 1). Once equilibrium is reached, more PAC must be added to adsorb an additional increment of the remaining impurities. A new equilibrium is then reached.

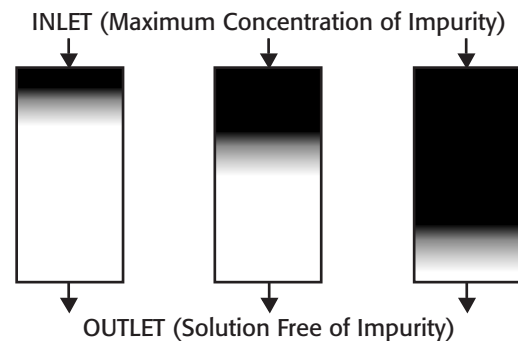
Figure 1
Impurity Concentration Equilibrium for a Powdered Activated Carbon (PAC) Batch System



A good analogy is to divide a number by two, $I \div 2$. For our purposes I = impurities and 2 = PAC dosing. When I is divided by two, half of I still remains. Therefore, when I starts as a large amount, additional dosing is required to reach lower impurity levels. Because equilibrium is always established at concentrations lower than the initial solution concentration, a greater amount of carbon is required in batch systems to achieve a given purity level in the processed fluid.

In contrast to batch systems, dynamic adsorption systems are designed to make efficient use of the carbon without additional dosing. In a dynamic or fixed bed adsorber, the carbon equilibrates with the initial concentration of impurity instead of with the final concentration as indicated with PAC. This optimizes carbon use and provides complete removal of impurities (Figure 2).

Figure 2
An Impurity Concentration Gradient Progressing Through a Dynamic Carbon Adsorption System



- Stage 1: (Early in treatment) most of the carbon bed is available for adsorption.
- Stage 2: Zone of adsorption is moving through the carbon bed.
- Stage 3: Carbon bed is near saturation (note the efficient use of the carbon bed).

Additional Advantages of Dynamic Adsorption

Dynamic adsorption systems are low maintenance compared to PAC. A dynamic adsorption bed or column of GAC adsorbs impurities as the process fluid flows through it. By comparison, PAC must be measured (dosed), added, and then mixed in a batch operation. After adsorption the PAC has to be separated from the treated solution. Many PAC users also complain about the dust and mess of PAC handling.

It takes less GAC than PAC to adsorb the same amount of impurities. In fact, dynamic adsorption systems handle fluctuations in impurities more efficiently. When impurity concentrations vary in a process fluid, a dynamic adsorption system adsorbs the higher concentration without additional dosing and mixing.

Dynamic adsorbers do not have the disposal costs and concerns of PAC systems. PAC adsorbs impurities on a dose-per-batch treatment basis. "Spent" PAC, as well as filter aid used to remove the PAC, must be handled as a solid waste. Dynamic adsorption systems do not require the use and disposal of filter aid. In addition, GAC systems can be reactivated and recycled, further minimizing waste generation.

PAC TO GAC

Converting PAC Users to Dynamic Adsorption with GAC



Each of these advantages of dynamic systems saves operating costs. Companies that minimize disposal of spent carbon have an environmentally friendly and responsible image. Powdered carbon users who can take advantage of the benefits of dynamic treatment with GAC include: electroplaters, breweries, wineries, distilleries, soft drink companies, juices, sweeteners, foods, chemicals and pharmaceuticals, and others who treat wastewater, decolorize sugar, and purify drinking water.

Case Studies of Specific Applications

Case I

Calgon Carbon piloted dynamic adsorption systems to remove chlorine and chloramines from city water used in a beverage making process. Only 75% of these impurities were removed by PAC in a batch mixing tank, with the remainder removed in a pressure filter. Each time the filters were cleaned, at least four hours of filter cake buildup were needed to reestablish complete removal of impurities. Further, the city increased the residual chlorine concentration from 0.5 ppm to 1.0 ppm.

The PAC dosage was 1 lb. per 1,000 gallons of water. The dynamic adsorption system used a maximum of 0.4 lb. GAC per 1,000 gallons, with no chlorine breakthrough. The pilot study demonstrated that the beverage producer can simplify operations, eliminate PAC disposal, reduce carbon consumption and labor requirements, and improve treatment system reliability while completely removing chlorine.

Case II

A food-grade dye manufacturer, frustrated with the mess of PAC handling and disposal, reduced carbon usage per 5,000 gallon batch from 160 lb. of PAC to 27 lb. of GAC with a Calgon Carbon 1,000 lb. Cyclesorb® FP1 adsorption system.

Product Options

If the current liquid processing design in your plant includes batch treatment with PAC, consider the product alternatives that Calgon Carbon Corporation can offer which provide the advantages of dynamic adsorption:

Granular Carbon Products

Type APA, CPG, SGL, and CAL activated carbons for food grade or high purity pharmaceutical applications.

Equipment Products

Standardized, pre-engineered adsorption systems capable of treating liquid flows from 1 gpm to 1,400 gpm.

Service Products

On site exchange services and reactivation service reduce labor requirements and minimize disposal costs.

Calgon Carbon's technical support can help to evaluate the effectiveness of dynamic adsorption for your specific application. Technical support includes design assistance, calculation of carbon use rates, laboratory and pilot studies, and start-up and operating assistance.

If you would like more information about how Calgon Carbon can help you gain the advantage of dynamic treatment with GAC over PAC batch treatment, please contact your local Calgon Carbon inside sales representative at 1-800-422-7266.



CALGON CARBON CORPORATION

Calgon Carbon Corporation
P.O. Box 717
Pittsburgh, PA USA 15230-0717
1-800-422-7266
Tel: 412-787-6700
Fx: 412-787-6713

Making Water and Air Safer and Cleaner

Calgon Carbon Asia
65 Chulia Street
#37-03 OCBC Centre
Singapore 049513
Tel: +65 6 221 3500
Fx: +65 6 221 3554

Chemviron Carbon
European Operations of
Calgon Carbon Corporation
Zoning Industriel C de Feluy
B-7181 Feluy, Belgium
Tel: + 32 (0) 64 51 18 11
Fx: + 32 (0) 64 54 15 91

Your local office

