

## C&S Brand Activated Carbons for Potable Water Treatment

Both Powdered Activated Carbon (PAC) and Granular Activated Carbon (GAC) are utilised in potable water treatment for the removal of unpleasant or toxic dissolved organic compounds, which could render the water unpalatable or hazardous to drink. These compounds can be naturally occurring or synthetic, and can include algal derived tastes, odours and toxins, colour compounds, surfactants, agricultural chemicals, Trihalomethanes or other disinfection by-products, phenols, chlorinated hydrocarbons, VOCs, etc. - such compounds can be treated with Activated Carbon to comply with, or exceed, drinking water quality requirements.

### Powdered Activated Carbons

C&S Brand Powdered Activated Carbons are utilised in several Australian Water Treatment Plants where it has been deemed more economical to dose Powdered Activated Carbon where tastes, odours and/or toxins are encountered in the raw water supply, rather than to install a Granular Activated Carbon system.

Extensive laboratory testwork, and full-scale plant trials, have shown that C&S Brand Powdered Activated Carbons can remove the blue-green algal derived taste and odour compounds, geosmin and 2-methylisoborneol, to below detectable levels at dosage rates of around 5mg/litre and mixing times of as few as 10 minutes. The blue-green algal toxin, microcystin-LR, can be removed to levels below 1 nanogram per litre at dosage rates of 30-100mg/litre, and mixing times of 30-120 minutes, depending on the initial toxin concentration.

Powdered Activated Carbon is most often dosed into the raw water stream, where it is pulled out in the clarification step, or prior to the filtration step (i.e. after the clarifier) where it is pulled out on the filter. The choice of which of the two is utilised is a function of the raw water quality and/or the plant configuration. Since the efficiency of Powdered Activated Carbon is dependent to a large extent on mixing time, it is preferable, where the carbon is dosed ahead of the clarifier, to dose the product as early in the process as possible; in some plants, the carbon is dosed into the raw water pipeline, well in front of the inlet works.

Powdered Activated Carbon can be stored dry on site in bags or silos, to be mixed and utilised only as required, or can be stored in water slurry form at slurry concentrations of typically up to 10 percent. Where the PAC is stored in slurry form, it must be continuously agitated to prevent settling.

C&S Brand PACs from coal, wood and coconut shells can be utilised in potable water applications. While coal-based PACs have been shown to be the most effective for all-round potable water treatment, including the removal of algal-derived tastes, odours and toxins, some water treatment plant operators prefer, for various reasons, to use either wood based or coconut shell based Powdered Activated Carbons.

### Granular Activated Carbons

C&S Brand Granular Activated Carbons are utilised in potable water treatment in fixed-bed gravity adsorbers, or in pressure vessels.

Laboratory and pilot plant testwork have demonstrated that the algal derived taste and odour compounds, geosmin and 2-methylisoborneol, can be removed to below detectable levels using C&S Brand Granular Activated Carbons at 8 minutes Empty Bed Contact Time. Similarly, microcystin-LR removal, from an influent level of 20µg/l down to an effluent level of less than 1 nanogram per litre, has been achieved at an Empty Bed Contact Time of 15 minutes, with effective colour removal as well. Tests have further indicated that, dependent on raw water quality, C&S Brand Granular Activated Carbons have an anticipated life span, under the above conditions, of 2-4 years for the removal of taste, odour, toxin and other dissolved organics.

C&S Brand Granular Activated Carbons can be readily installed in existing filter beds, either as a replacement for coal type filter media in dual media filters (where some of the sand may be removed as well) or as a replacement for a large portion of the sand in monomedia filters. Since the Granular Activated Carbon is required to perform both as an adsorption medium, and as an effective filter medium, the Particle Size and the Uniformity Coefficient of the GAC are important. Modifications to the filter (e.g. raising of backwash troughs) may be necessary to ensure sufficient Empty Bed Contact Time for effective dissolved organics removal. Because of the lower bulk density of the GAC, when compared with the sand or coal filter media, modifications to the backwashing regimen may be necessary.

At the Grahamstown Water Treatment Plant (Hunter Water Corporation), C&S Brand Filter Coal was removed from the filter bed, the sand layer was reduced to 100mm depth, and both were replaced with an 8x16 Mesh C&S Brand Granular Activated Carbon. At the normal filtration rates of 8 cubic metres per square metre per hour, filter run lengths of in excess of 24 hours, before backwashing, were achieved, where TOCs in the raw water were in the 6-8mg/litre range. The treated water quality, when measured against the previous dual-media, met the required standards.

Granular Activated Carbon can also be utilised in a post-adsorption mode, i.e. subsequent to conventional water treatment processes, either in gravity systems or in pressure vessels. It has also been utilised ahead of conventional water treatment processes, to remove dissolved organics which might have a significantly detrimental effect on the subsequent water treatment processes. In both these instances, filtration ability is not a consideration; the GAC is selected for its adsorption efficiency, head-loss characteristics, and abrasion resistance.

Granular Activated Carbon, in conjunction with Ozone, is also used in an advanced water treatment process called the Biological Activated Carbon (B.A.C.) Process. C&S Brand coal-based GACs have been demonstrated to have superior performance to other types of GACs when used in this process (see Client Data Sheet CDAC05).

Properties required for Granular Activated Carbon for potable water treatment include:

- Adsorption efficiency; to remove a wide range of dissolved organic compounds from water;
- Hardness; to ensure maximum particle integrity under frequent backwash and air scour regimens;
- Granulometry; to ensure minimum headloss, and optimum filtration efficiency when used in adsorption/filtration mode;
- High Activity; to ensure maximum effective operational life;
- High Purity; to ensure compliance with relevant standards for products which come in contact with foods;
- Low Cost; for most cost-effective operation.

James Cumming & Sons Pty Ltd supply Granular Activated Carbons manufactured from coal, wood and coconut shells. Because of their broad Pore Size Distribution (and therefore their ability to adsorb a wide range of dissolved organic compounds), and their hardness and low cost, coal based Granular Activated Carbons are the most widely used for potable water treatment, either in conventional adsorption mode, adsorption/filtration mode, or in the Biological Activated Carbon Process.