CalgonCarbon™

GLENDALE, ARIZONA, CASE STUDY :

Re-agglomerated Carbon Helps City of Glendale Meet Taste, Odor and Disinfection Byproducts Compliance

Oasis Water Treatment Process
(Oasis poster explanation)

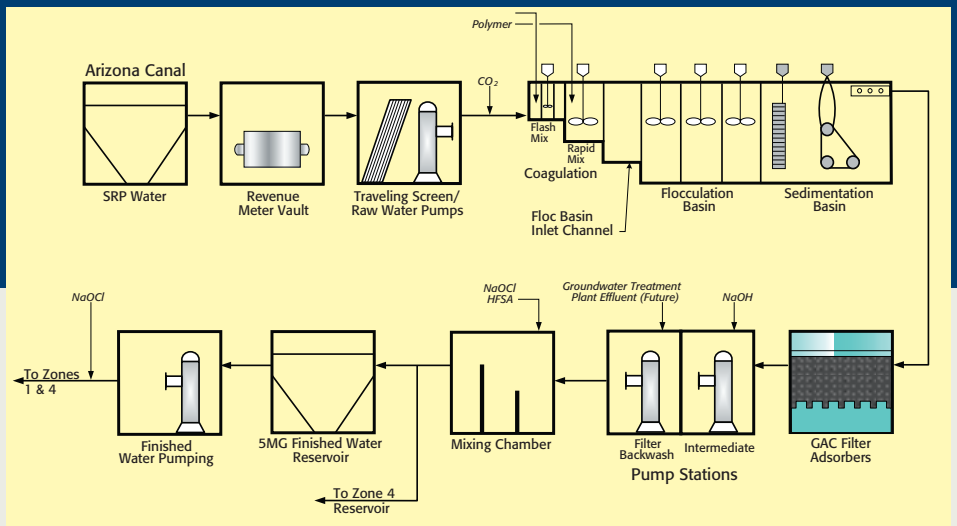
Water flows down four miles through water conveyance pipe from the Arizona Canal Salt River Project (SRP). It goes through a revenue meter where the City is billed on what comes into the plant. At the traveling screen/raw water pumps, anything larger than a 1/4 inch is removed; Carbon Dioxide (CO_2) is added to lower the pH to 6.6. Immediately following pH adjustment, aluminum sulfate and cationic polymer are added during the flash mixer/rapid mix stage to ensure proper mixing of the chemicals and water. The water then goes through three stages of flocculation.

In the sedimentation basin, the process of removing disinfection byproduct precursors begins. The processed water then goes into the re-agglomerated GAC filters, where the total organic carbons (i.e. the disinfection byproduct precursors) are reduced even further. An intermediate station pumps the combined filter effluent to the reservoir mixing chamber. Oasis has the ability to introduce ground water that it can blended into the surface water here. The mixing chamber assures a good blend of the two waters.In that same area, disinfectant (sodium hydrochlorite) is added. From there the water flows into the reservoir and then out to the distribution system.

For the City of Glendale, Arizona, delivering high quality water to the community is a primary goal. But Glendale, like many cities that rely on surface water for their needs faced unique water quality challenges. Seasonal taste and odor issues, caused by the algae that propagate in warm temperature water, were one problem, causing the City to receive, on average, between 600 and 800 complaints annually. More important was the need to comply with the US Environmental Protection Agency (EPA) Stage 2 Disinfectant and Disinfectant Byproducts Rule (DBPR) which is designed to help reduce potential cancer and other health risks in drinking water.

To address these issues effectively, the City of Glendale initiated a Water Master Plan and Facility Process Evaluation as part of a comprehensive water facilities planning and design project. Completed in 2003, the Master Plan led to improvements in older facilities as well as new plant development. In addition, the City turned to re-agglomerated granular activated carbon (GAC) from Calgon Carbon Corporation as its solution of choice for solving its taste and odor challenges, achieving EPA Stage 2 DBPR compliance, and as a hedge against future EPA compliance regulations. Studies conducted by and for the City showed a Triple Bottom Line benefit for the re-agglomerated carbon including: life cycle savings, up front capital cost reduction, and lower operations and materials expenses. In addition, by choosing to reactivate the bituminous, domestically-produced carbon, the City could reduce both its spent fuel disposal costs and its carbon footprint.

Glendale Oasis Water Treatment Plant Process Schematic



Glendale's Water Treatment Infrastructure

The City of Glendale purveys water to a service area of about 300,000 people. This includes the City of Glendale itself, as well as the 55,000 residents of Peoria, Arizona, and approximately 1,500 residents in Phoenix.

Three water treatment facilities service these communities: Pyramid Peak, Glendale's only dual-media, anthracite-over-sand water treatment plant; and two other facilities, Cholla Water Treatment Plant and the new Oasis Water Campus, both of which are mono-media, GAC facilities that practice pH-controlled enhanced coagulation. These latter facilities service nearly 60% of Glendale's community – 245,000 residents – with Cholla rated at delivering 30 million gallons of water per day (MGD) and Oasis rated at 12.5 MGD.

The Cholla and Oasis facilities treat water from the Salt River Project (SRP) Arizona Canal for potable use. The SRP water comes from the Salt and Verde Rivers into a system of seven storage reservoirs in the metropolitan Phoenix area.

Originally commissioned in 1976, Cholla has had several upgrades. In 2006 the plant completed a two-year project to convert four conventional anthracite-and-sand filters to deep bed GAC and added two additional deep bed GAC filters. New solids removal equipment was installed in the sedimentation basins and a new chemical feed system also was added to control the pH of the water during the treatment process.

Glendale's all-new facility, the Oasis Water Campus, which started processing water in late 2007, was designed from the start to accommodate deep bed mono-media GAC filters. More than thirty years younger than the Cholla plant, it follows the same basic processes for water treatment although it is also equipped to take and mix ground water into the potable water supply.

Both the new Oasis plant and renovated Cholla plant were planned with the use of re-agglomerated carbon in mind. By allowing the GAC to go biologically active, the plants are able to attain an additional 10-to-15% of total organic compound (TOC) removal.

These efforts have reduced seasonal taste and odor-causing materials in the water supply, while also providing effective filtration.

Glendale's Water Treatment Challenges and How It Has Met Them

Uncovered canals, 30 to 150 miles away, deliver surface water to Glendale's treatment plants. Evaporation along the way elevates the high mineral concentration in the relatively hard source water, resulting in even higher total dissolved solids and hardness.

The surface water coming into the facilities can rise to 102 degrees Fahrenheit during the summertime, according to Rick Scott, Superintendent of Water Treatment Plants for the City of Glendale. "By the time water reaches the first customer, it's 100-to-105 degrees," said Scott. "If there are taste and odor compounds in the water, the heat just exascerbates it. Solving these as well as the Stage 2 Disinfection Byproduct Rule were the biggest drivers behind our move to re-agglomerated deep bed carbon."

The City did almost two years of piloting – from late 2002 to early 2004 – of different processes and treatments. Said Scott: "We wanted to look at all the conventional technology that was out there. We started with what we thought would have been the cheapest process improvements and piloted those. We piloted chloramines, but with the water temperatures here we didn't feel we could control the re-nitrification. We also piloted ozone as well as some other processes, but because our surface water has so many bromated species in it, we ended up over the MCL (maximum contaminant level) for bromates. We found that for every problem these treatments solved, they actually created one or two more. We then piloted GAC for removal of the organic disinfection by-product precursors. It allowed us to achieve the total organic compound removal we needed as well as solve our taste and odor problems."

"What it finally came down to was either GAC or chloramines. And we didn't feel we could control the chloramines. Also, the two other cities we deliver water to have a free chlorine system. If we went to chloramines, they could no longer accept our water or they'd have to convert to chloramines and they were against that," Scott said.

By the end of the piloting in 2004, the decision was made to move forward on deep bed GAC. At this time, the City started to concurrently design the Oasis treatment plant and the retrofit of the filters for the Cholla facility. The latter facility was designed by the consulting firm of Malcolm Pirnie. The Oasis campus was designed by Black & Veatch. Both firms worked together with the City throughout the piloting phase.

Glendale is also a member of the Arizona State University (ASU) Water Quality Technology Group and has benefited from ASU's water research studies on the problems created by chemicals not yet regulated by the EPA in the public water supply. These include personal care products and pharmaceuticals like prescription and non-prescription medicines, hormone replacement therapies, etc. With the GAC filters in place and other improvements it's made, Glendale feels it has the best technologies to address potential future regulatory compliance issues as well.

About Disinfection Byproducts

Disinfection byproducts (DBPs) form when disinfectants used to treat drinking water react with naturally occurring compounds in the water, such as decomposing plant material. Studies indicate that DBP exposure can lead to bladder and intestinal cancers. They have also been shown to pose reproductive and developmental defects.

Useful indicators for DBPs in chlorinated drinking water include the presence of trihalomethanes and haloacetic acids. The EPA Stage 2 DBP rule regulates the presence of the following compounds throughout the drinking water distribution system:

Total Trihalomethanes (TTHMs):

- Chloroform ($CHCl_3$)
- Bromodichloromethane ($CHBrCl_2$)
- Dibromochloromethane ($CHBr_2Cl$)
- Bromoform ($CHBr_3$)

Five Haloacetic Acids (HAA5)

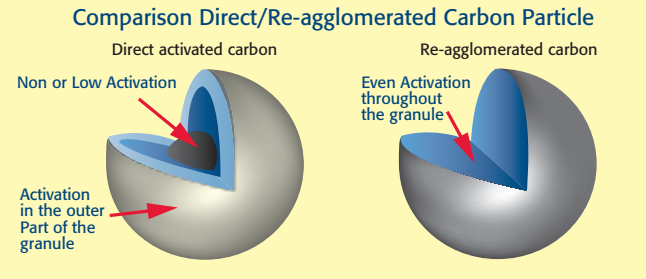
- Monochloroacetic acid ($C_2H_3ClO_2$)
- Dichloroacetic acid ($CHCl_2COOH$)
- Trichloroacetic acid (CCl_3COOH)
- Bromoacetic acid ($C_2H_3BrO_2$)
- Dibromoacetic acid ($C_2H_2Br_2O_2$)

Why Re-agglomerated Carbon?

Before selecting Calgon Carbon's FILTRASORB™ 820 – an 8x20 mesh, re-agglomerated bituminous coal-base, virgin activated carbon – for its Oasis and Cholla filter beds, Glendale set up test beds for a variety of other types of carbon. In addition to conducting pilots with re-agglomerated carbon, the City looked at coconut and wood base carbons, as well as carbon imported from China. They also sent test samples to ASU to do iodine adsorption testing.

"The carbon imported from China lasted about 2 ½ months and had about 1/3 of the adsorptive life as the Calgon re-agglomerated carbon. The wood base and the coconut base products lasted about 4-to-4 ½ months. The re-agglomerated coal base lasted until the end of the pilot – which was 6 months – and we didn't finish working off its adsorptive state. It was, by far, the best performer. It just came down to the fact that it was more cost effective to spend a little more money up front for the re-agglomerated carbon. That's one of the things that drove us to the current carbon," explained Scott.

The Benefits / Necessity of Re-agglomerated Product over Direct Activated when Reactivation is being considered



Making the Case for Carbon Reactivation

Glendale originally started using GAC as a media cap in its Cholla plant in 2005. At that time carbon reactivation wasn't considered since the amount of spent carbon Glendale was generating was minimal and, as a result, land fill costs were a relatively minor issue. When the Glendale plants went to a deep-bed, mono-media GAC base, they required a lot more carbon: 80,000 pounds per filter at Oasis and 140,000 pounds per filter at Cholla. At those quantities, land-filling spent carbon was economically out of the question. So, the City turned to reactivation in 2007 as a way to reduce its filter media related operations and materials costs.

Today, some of Glendale's carbon is on its third reactivation cycle, according to Rick Scott. "We segregate the reactivated carbon by plant. We run a chain of custody from the time Calgon Carbon removes the spent carbon from the filter to where it goes for reactivation, finishes react, and is redelivered back to the same facility from which it came." Currently the Glendale plants use a blend of 80% reactivated carbon and 20% virgin due to a minor loss of volume during the reactivation process.

Glendale has found that the reactivated carbon does an exceptional job as compared to virgin GAC of filtering turbidity levels that are recognized < 10 um. "Reactivated carbon filters are a strong competitor with virgin," said Scott, "and a blend of both works really well. We're also finding that the lifecycle for virgin versus reactivated carbon is almost analogous."

For Glendale, reactivation is not just an economic gain; it's an environmental plus as well. Through reactivation, spent carbon from the Glendale plants can be recycled for reuse, eliminating the costs and long-term liability associated with disposal. Not only does custom reactivation save rate payers money, but reactivating carbon produces only 20% of the CO_2 emissions required to manufacture virgin activated carbon. So, the carbon footprint is considerably reduced.

Glendale's water treatment plant

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