Technical Note

MIEX® Treatment Versus GAC for TOC Removal

Life-cycle Cost Comparison

Introduction

When conventional coagulation and filtration treatment cannot remove enough total organic carbon (TOC) to allow compliance with EPA disinfection byproduct (DBP) standards, GAC adsorbers can be placed as a polishing step or the MIEX® Process can be used as pre-treatment to meet a TOC removal target that will meet DBP standards after subsequent disinfection. Both pre-treatment with the MIEX® Process and post-treatment with GAC adsorption columns are proven means of reducing treated water TOC levels to achieve DBP standards. There are significant differences in the life-cycle costs of each option, depending on the TOC removal requirement and potential impacts on performance of the existing treatment plant. This technical note compares life-cycle costs of the MIEX® Process and GAC adsorbers for achieving compliance with EPA DBP standards.

Increasing Carbon Costs

When the EPA nominated GAC in 1998 as a best available technology to provide compliance with the upcoming Stage 1 and Stage 2 DBP standards, the price of GAC was well under 50 cents per pound. A combination of an import tariff imposed on Chinese carbon in 2007 and a restricted world supply has resulted in a significant increase in the price of GAC to well over $1.00 per lb. The service life of GAC is directly proportional to the amount of TOC that needs to be removed and therefore the cost of GAC replacement has made operational costs prohibitive for TOC removal, especially where the GAC system is required to remove more than 0.5 to 1.0 mg/L of TOC. GAC can be reactivated but this is this only feasible for very large water treatment plants due to the high capital costs of the reactivation system.

Impact on Existing Treatment Plant

Removing TOC with a MIEX® Pre-treatment system provides a number of benefits for downstream treatment processes that are not realized with a GAC polishing system including:

- Reduction in coagulant dose and subsequent sludge volumes.
- Reduction in alkali use due to lower coagulant dose.
- Improved membrane performance due to reduced organic loading.

Where post filter GAC adsorbers are used for TOC removal, it is often recommended that enhanced coagulation be also practiced upstream to reduce the TOC loading on the GAC and extend the carbon service life to reduce operating costs. This practice therefore results in increases in coagulant, alkali and sludge handling costs in addition to the GAC replacement cost.

Life-cycle Cost Comparison

While the capital cost of GAC adsorbers may be competitive with capital costs of other TOC removal options, extremely high operating costs due to carbon replacement often make GAC the most expensive option based on life-cycle cost. A comparison of the capital, operating and 20-year present worth costs for MIEX® Pre-treatment versus GAC are shown for a 30-MGD WTP in Figure 1. While GAC adsorbers are competitive with the MIEX® Process on capital cost, after operating costs are taken into account, the MIEX® Process life-cycle cost is significantly lower. The costs in Figure 1 do not take into account cost reductions for coagulant and sludge handling after MIEX® pre-treatment which will further widen the life cycle cost difference between MIEX® and GAC treatment.

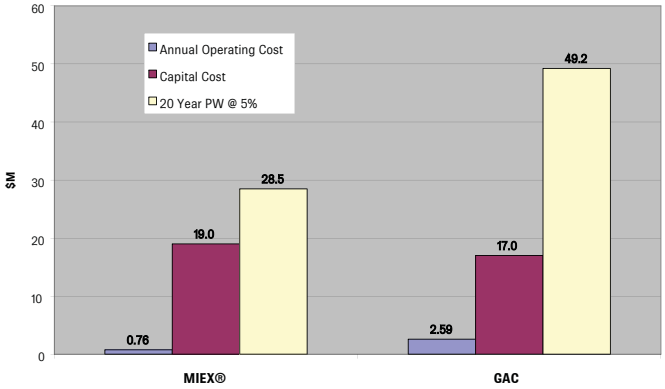

Figure 1: Life-cycle Cost Comparison for a 30-MGD WTP at 20 MGD average throughput and $1.10/lb GAC price.

[1]GAC consumption for lowering treated water TOC by 1 mg/L based on report on AWWARF Project #3075, "DBP Control in High Bromide Water While Using Free Chlorine During Disinfection," 2006. GAC price used in report was $0.33/lb.

KBTN092016

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