

operated for a longer period of time. Based on these considerations, and the analysis of subject matter experts, it was concluded that the proposed combination of GAC empty bed contact times and reactivation/replacement intervals were reasonable for BAT.

The Information Collection Rule treatment study results also demonstrated that nanofiltration was the better DBP control technology for ground water sources with high TOC concentrations (*i.e.*, above approximately 6 mg/L). The results of the membrane treatment studies showed that all ground water plants could meet the 0.080 mg/L TTHM and 0.060 mg/L HAA5 MCLs, with a 20% safety factor (*i.e.*, 0.064 mg/L and 0.048 mg/L, respectively) at the average distribution system residence time using nanofiltration. Nanofiltration would be less expensive than GAC for high TOC ground waters, which generally require minimal pretreatment prior to the membrane process. Also, nanofiltration is an accepted technology for treatment of high TOC ground waters in Florida and parts of the Southwest, areas of the country with elevated TOC levels in ground waters.

ii. *BAT analysis using the SWAT.* The second method that EPA used to examine alternatives for BAT was the SWAT model that was developed to

compare alternative regulatory strategies. EPA modeled the following BAT options: enhanced coagulation/softening with chlorine (the Stage 1 DBPR BAT); enhanced coagulation/softening with chlorine and no predisinfection; enhanced coagulation and GAC10; enhanced coagulation and chloramines. Enhanced coagulation/softening is required under the Stage 1 DBPR at subpart H conventional filtration plants. In the model, GAC10 was defined as granular activated carbon with an empty bed contact time of 10 minutes and a reactivation or replacement interval of 90 days or longer. GAC20 was defined as granular activated carbon with an empty bed contact time of 20 minutes and a reactivation or replacement interval of 90 days or longer. EPA assumed that systems would be operating to achieve both the Stage 2B MCLs of 0.080 mg/L TTHM and 0.060 mg/L HAA5 as an LRAA and the SWTR removal and inactivation requirements of 3-log for *Giardia* and 4-log for viruses. EPA also evaluated the BAT options under the assumption that plants operate to achieve DBP levels 20% below the MCL (safety factor). These assumptions along with other inputs for the SWAT runs are consistent with those used in the

Economic Analysis of today's proposed rule (USEPA 2003i).

The compliance percentages forecasted by the SWAT model are indicated in Table V-1. EPA estimates that more than 97% of large systems will be able to achieve the Stage 2B MCLs regardless of post-disinfection choice if they were to apply one of the proposed GAC BATs, *i.e.*, enhanced coagulation (EC) and GAC10 (Seidel Memo, 2001). As shown in the Stage 2 DBPR Occurrence document (USEPA 2003o), the source water quality (*e.g.*, DBP precursor levels) in medium and small systems is expected to be comparable to or better than that for the large systems. Based on the large system estimate, EPA believes it is conservative to assume that at least 90% of medium and small systems will be able to achieve the Stage 2B MCLs if they were to apply one of the proposed GAC BATs. EPA assumes that small systems may adopt GAC20 in a replacement mode (with replacement every 240 days) over GAC10 because it may not be economically feasible for some small systems to install and operate an on-site GAC reactivation facility. Moreover, some small systems may find nanofiltration cheaper than the GAC20 in a replacement mode if their specific geographic locations cause a relatively high cost for routine GAC shipment.

TABLE V-1.—SWAT MODEL PREDICTIONS OF PERCENT OF LARGE PLANTS IN COMPLIANCE WITH TTHM AND HAA5 STAGE 2B MCLs AFTER APPLICATION OF SPECIFIED TREATMENT TECHNOLOGIES

| Technology *                    | Compliance with 0.080 mg/L (TTHM)/0.060 mg/L (HAA5) LRAAs |            |             | Compliance with 0.064 mg/L (TTHM)/0.048 mg/L (HAA5) LRAAs (MCLs with 20% safety factor) |            |             |
|---------------------------------|---|------------|-------------|---|------------|-------------|
|                                 | Residual disinfectant                                     |            | All systems | Residual disinfectant   |            | All systems |
|                                 | Chlorine  | Chloramine |             | Chlorine  | Chloramine |             |
| Enhanced Coagulation (EC) ..... | 73.5  | 76.9       | 74.8        | 57.2  | 65.4       | 60.4        |
| EC (no predisinfection) .....   | 73.4  | 88.0       | 78.4        | 44.1  | 62.7       | 50.5        |
| EC & GAC10 .....                | 100   | 97.1       | 99.1        | 100   | 95.7       | 98.6        |
| EC & GAC20 .....                | 100   | 100        | 100         | 100   | 100        | 100         |
| EC & All Chloramines .....      | NA  | 83.9       | NA          | NA  | 73.6       | NA          |

\* Enhanced coagulation/softening is required under the Stage 1 DBPR for conventional plants.

b. *Basis for the Consecutive System BAT.* EPA believes that the best compliance strategy for consecutive systems is to collaborate with wholesalers on the water quality they need. For consecutive systems that are having difficulty meeting the MCLs, EPA is proposing a BAT of chloramination with management of hydraulic flow and storage to minimize residence time in the distribution system. EPA is proposing a different BAT than for wholesale systems because a consecutive system's source water has already been disinfected and contains DBPs that cannot be effectively removed

or controlled with the BATs proposed for wholesale systems. EPA believes the proposed consecutive system BAT is an effective means for consecutive systems to meet the MCLs.

Chloramination has been used for residual disinfection for many years to minimize the formation of chlorination DBPs, including TTHM and HAA5 (Stage 2 Technology and Cost Document, USEPA 2003k). The BAT provision to manage hydraulic flow and minimize residence time in the distribution system is to facilitate the maintenance of the chloramine residual and minimize the likelihood for

nitrification. Nitrification, the process by which microbes convert free ammonia to nitrate and nitrite, is a concern for systems using chloramines. Nitrification, however, can be controlled with appropriate chlorine to ammonia ratios, increasing flow in low demand areas, and increasing storage tank turnover. EPA proposes that systems implementing the consecutive system BAT must do the following: (1) Maintain a chloramine residual throughout the distribution system, (2) develop and submit a plan that indicates actions that will be taken to minimize the residence time of water