City of Warrenton Georgia
Water Treatment Plant

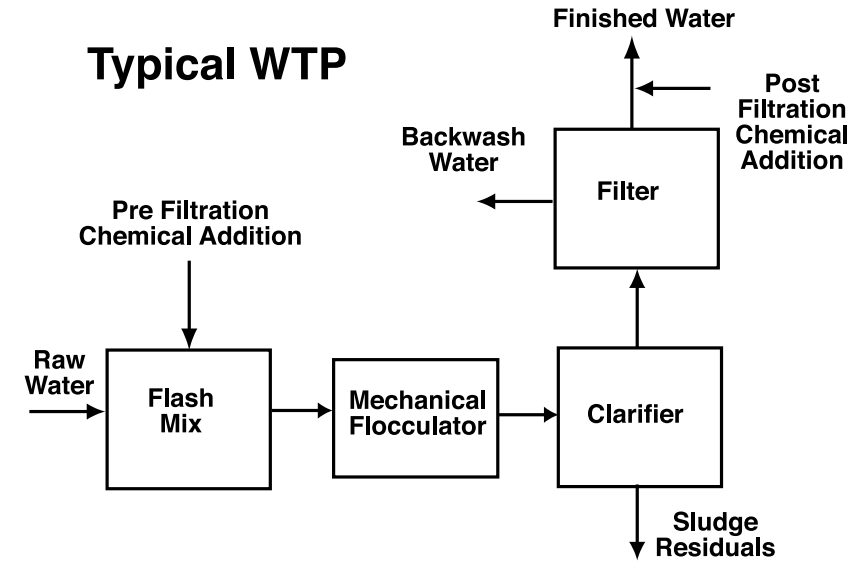
Warrenton Georgia is a town of approximately 2500 people located in the North East quadrant of Georgia about 50 miles West of Augusta. The town draws its water from the Rocky Creek Reservoir, a 318 acre rural and heavily wooded water-shed. Water is pumped at an average daily rate of about 0.5 MGD through a classical 20 year old filtration plant consisting of a rapid mix tank, a statically mixed flocculation section, clarification and filtration.

The quality of the water supply varies greatly in color, manganese, iron and turbidity depending upon the season and precipitation events. The water is considered quite soft with negligible quantities of calcium and magnesium, a pH range of 6 to 7 and alkalinity of less than 5 to 10 ppm.

The WTP has gone through some tough times lately. During the late 80's the plant finished water quality was frequently below state standards resulting in an expenditure of $500,000 to replace the filter beds and install instrumentation to better monitor the process. These modifications where completed in 1992 but problems remained. High turbidity and occasional brown and black water problems caused by breakthrough of iron and manganese continued and as late as February 1994 the City was under a "Boiled Water Order" by Georgia's Department of Natural Resources (GEPD).

Warrenton's WTP operation was not unlike most plants of similar design. Alum is used as the primary coagulant and lime was added to provide the alkalinity required to hydrolyze the alum. Potassium permanganate was added along with the alum and lime in the rapid mix tank to oxidize and precipitate the manganese and iron contaminants. A polymeric flocculating compound was added during the clarification operation to scarf up unsettled particles left behind by the alum. Post filtration lime was added to increase the pH and a blended phosphate was added for corrosion control.

FIGURE I



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Under this scenario the plant was back-washing its filters every 20 hours attempting to compensate for the poor performance of its flocculation and clarification operations. As stated the turbidity and color of the finished water was often below standard and the pH of the finished water was extremely difficult to control and would range between 8 and 10.

Fred Finley a former manager of GEPD and currently a technical adviser to the Georgia Rural Water Association was made aware of Warrenton's problems and suggested that the source of the problem may lie in the low alkalinity of the source water. Fred was aware of a similar situation in Jefferson GA in which alkalinity supplementation with sodium bicarbonate dramatically improved filtration plant operation. Fred put Warrenton's plant manager, Freddie Wiggins in touch with Beverly Schwartz, Church & Dwight Company's district sales manager.

Based upon her experience at the City of Jefferson Beverly surmised that Fred Finley's assessment was correct and that the optimum hydrolysis of the alum was hindered by the insolubility ofthe lime and resulting pH swings. Upon her recommendation Fred Wiggins replaced "pre-lime" additions to the rapid mix tank with sodium bicarbonate to add 20 ppm of alkalinity to the water. According to Mr. Wiggins and plant operator Garrett Combs, the alkalinity response was immediate.

The improvements brought about by this change in operating philosophy were equally fast and quite dramatic:

- The replacement of lime with sodium bicarbonate in the Rapid Mix provided alkalinity in the optimum pH range for alum hydrolysis eliminating the overfeed of alum. This eventually allowed for the reduction of alum usage from 50 ppm to 8 ppm.
- Pre-lime usage of 150 pounds per day was eliminated and post lime addition for pH control was reduced from 100 pounds per day to less than 25 pounds per day.
- The flocculation process was much more efficient. Filter backwash cycles improved from less than 20 hours to 100 hours.
- Potassium-permanganate usage was reduced from 16 to 4 pounds per day and there are plans to eliminate it entirely.
- Iron and manganese levels in the finished water dropped to analytical detection limits. The improvements in water clarity in the clear-well are obvious to the naked eye.
- Finished water turbidity is now consistently below 0.02 NTU's.

Warrenton's original response to replacing pre-lime with an even greater quantity of more costly sodium bicarbonate was that it was very expensive. Beverly's response to this was that " it's only expensive if it doesn't work". These words have turned out to be prophetic as Warrenton's chemical budget has dropped significantly since using the bicarbonate as shown in the attached graphs. The bicarbonate cost was more than covered by reductions in alum and lime usage. The reduction and eventual elimination of permanganate increases the savings considerably. Furthermore since the finished water now contains sufficient alkalinity for corrosion control the use of blended phosphates becomes superfluous and this too will be eliminated from Warrenton's budget. Annual savings of 40% for chemicals were achieved.

This simple change in plant operation allows Warrenton to consistently provide its customers the safe high quality water they deserve and puts them on excellent terms with the Georgia state regulators.

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Chemical Usage
(pounds per day)

Chemical	Before Bicarbonate	After Bicarbonate	
		Current	Future
Alum	208 (50 ppm)	33.4 (8 ppm)	33.4 (8 ppm)
Aquidine	5	5	0
Pre-Lime	150	0	0
Post-Lime	100	25	25
Potassium-Permanganate	15.7	3.7	0
Sodium Bicarbonate	0	150	225

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