ABSTRACT

The production of potable water by slow sand filtration was studied with respect to the potable water quality guidelines set by the Department of Health in South Africa. A plain sedimentation tank was used to pre-treat the raw water. During the first half of the study, raw water from the Umgeni river formed the feed water into the plain sedimentation-slow sand filtration pilot plant. Thereafter, raw water from the Inanda impoundment was fed into the pilot plant. The raw water from the Umgeni river was higher in turbidity and microbiological content than that from the Inanda impoundment.

The pre-treated raw water from the plain sedimentation tank formed the feed water into two slow sand filters. One slow sand filter was operated at a filtration rate of 0,1 m/h whilst the other was operated at 0,1 to 0,5 m/h. Both slow sand filters contained sand with an effective particle diameter of 0,3 mm.

Turbidity and microbiological sampling were performed to characterise the filtered water into aesthetic and health criteria respectively. Turbidity was monitored in the raw, pre-treated and filtered water whilst the microbiological content was monitored mainly in the raw and filtered water.

The change of raw water source from the Umgeni river to the Inanda impoundment was suited to a simple treatment process like slow sand filtration. The treatment of *Inanda raw water* was beneficial in terms of slow sand filter operation and filtered water quality. Indications are that *Inanda filtered water* is microbiologically and aesthetically safe even when the slow sand filter is operated at filtration rates as high as 0,5 m/h during *normal filtration* i.e. after *filter recovery*. In addition, the treatment of *Inanda raw water* results in over a 81 % saving in SSF downtime when compared to *Umgeni raw water*. Whereas a filtration cycle time of 2 to 3,5 months results for the treatment of *Umgeni raw water*, the respective filtration cycle time for *Inanda raw water* lasts up to 1 year. Thus slow sand filtration was recommended as a useful treatment process for an impounded water source where natural treatment processes like settling are already taking place.

A slow sand filter feed water turbidity of 7 NTU resulted in the filtered water conforming to both aesthetic and microbiological guidelines. Nevertheless post-disinfection of the filtered water was still recommended, especially during *filter recovery*.

The performance of both plain sedimentation and slow sand filtration was characterised by an increasing trend of treated water turbidity with feed water turbidity. Nevertheless, the performance of plain sedimentation was enhanced at high turbidity feed waters.

A *filter recovery* period of 4 d was estimated for the treatment of *Inanda raw water* by SSF. However, this *filter recovery* estimate of 4 d can potentially be less, especially if post-disinfection is practised. Although it is not necessary to increase the design daily water demand with respect to *Inanda raw water*, an increase of 20 % was recommended. The *filter recovery* period with respect to *Umgeni raw water* exceeded the 21 d generally mentioned in literature. The resultant downtime for the treatment of *Umgeni raw water* was

therefore not practical. Roughing filtration was recommended as a pre-treatment step to slow sand filtration if a river is the only available raw water source.

High filtration rates had more of an operational than a water quality effect on slow sand filtration. The frequency of filter cleanings increased with higher filtration rates. However high filtration rates together with high raw water turbidity and microbiology was detrimental to slow sand filtration with respect to both operation and filtered water quality.

Higher turbidity *Inanda raw water* than *Umgeni raw water* resulted in the filtered water conforming to the *no health risk* turbidity limit. *Umgeni raw water* seems to be composed of clay or colloidal material that passes through a plain sedimentation tank and slow sand filter.

Residence time distribution studies, non-woven filter mat pre-treatment, algal loading effects and suspended solids particle size measurements were recommended for future research work related to slow sand filtration.