23rd WEDC Conference Durban, South Africa, 1997

WATER AND SANITATION FOR ALL: PARTNERSHIPS AND INNOVATIONS

Odour testing using moringa carbon

V. Chipofya, Malawi and G. McConnachie et al., UK

PROVISION OF SAFE and potable drinking water to urban communities is a challenge to professionals in many low and middle income countries (WEDC, 1996). The situation is aggravated in those under-developed countries where agriculture is the mainstay of the economy. Fertilisers are extensively used in these countries and this leads to increased run-off of nutrients into surface water sources, with the negative consequence of prolific algal growths in the receiving waters. In Malawi, surface waters are the main source of drinking water, with only a small percentage of the supply being drawn from groundwater supplies. These surface waters are invariably infested with algae.

This paper assesses the degree of odour removal at a conventional water treatment plant (Lilongwe Water Works, Malawi) and a direct filtration plant (Blantyre water works, Malawi). The effect of ageing in a rapid gravity sand filter was also investigated to assess its effectiveness in odour removal as the filter-run progressed.

Methods

Production of powdered activated carbon (PAC) from waste seed husks of *Moringa* seeds.

2 cm depths of approximately 240g of *Moringa oleifera* waste seed husks placed in three stainless steel trays in a stainless steel box were heated in a steam atmosphere to 800°C for 30 minutes (Warhurst, McConnachie et al, 1996). Steam was generated by pumping water from a 20L jar into the steel box at the rate of 10mL/min using a peristaltic pump. Temperature inside the box was monitored by a thermocouple probe (type K probe, connected to a P.I.8013 thermometer from Portec, Milton Keynes, U.K) which entered through a hole on the front door of the furnace (type K2HT, supplied by Padmore & Sons Ltd, Shelton, Stoke-on-Trent, U.K), and through a purpose made hole on the door of the stainless steel box. The box was fabricated in Malawi, by Brown & Clapperton Ltd, and was designed to fit in the available furnace.

After 30 mins soak time, where temperature was held constant at 800°C (±10°C), the temperature inside the steel box was cooled slowly to about 200°C before the trays were removed to avoid ignition of the carbonised husks (char) in air. The char was then removed, allowed to cool for a few minutes and then weighed to determine percentage yield. The chars were later homogenised and sieved through a 250µm aperture T & C scientific test sieve and stored in a desiccater. Before any odour testing exercises, the chars were kept overnight in an oven at 110°C.

The adsorptive capacity of the Moringa PAC was ascertained through phenol adsorptive tests (Warhurst, McConnachie et al. 1997).

It is important that the activated carbon be produced in a container that does not corrode. This will prevent any corrosion material from impairing the quality of the carbon produced. Shallow charges of the precursor (1cm) result into ashing of the carbon. Deeper levels (>2cm) result in insufficient carbonisation.

Odour testing

The descending and ascending triangle test was used as a process control test to determine the threshold odour number (TON) at the different stages in the purification process (HMSO, 1994) with Moringa PAC used to treat any odorous water during the tests. A TON of 1 means that a water is free from odour. This is the desired state in drinking water supplies. A TON of about 3 means that odour is expected to be detectable in the supply by consumers.

Assessment of degree of odour removal at a conventional waterworks (Lilongwe Water works)

Raw, settled and filtered water samples from a conventional water treatment plant were taken and their TON determined (HMSO, 1994) in order to assess the intensity of odour present after the different stages of treatment (see table 1).

The effectiveness of rapid gravity sand filters in the removal of odour was also investigated by determining the TON of water samples collected at different times during a normal run of a selected filter. Samples were collected from the filter immediately after it was

Table 1. TON values and percentage (%) reduction of TON after settling and filtration

Table 2. TON for filtered water as a filter run progresses

backwashed and at 3 hour intervals thereafter. The last sample was collected just before the next backwash.

Duration of a filter-run was determined by the level of water in the filter.

Assessment of degree of odour removal at a direct filtration plant (Blantyre Waterworks)

Threshold order numbers were also established on raw water, flocculated water, and filtered water at a direct filtration plant so as to determine the degree of odour removal by the flocculation and filtration processes (see Table 3).

Results and discussion

Table 1 shows the average TONs for raw, settled and filtered water samples. The table also shows percentage reduction of odour levels after the sedimentation and filtration stages.

There is an 11 per cent reduction in raw water odour after the coagulatation/flocculation , and sedimentation process. The odour level in the settled water drops by 28 per cent after the filtration process. Figure 1 shows this systematic drop in the odour level.

There is an overall reduction of 36 per cent in the odour level of the raw water and the odour level in the filtered water.

As shown in Table 2, there is initially a high odour level in the filtered water immediately after a backwash. This is probably because chlorinated water is used for the backwash process and the chlorine imparts a chlorinous smell to the water. A subsequent sample shows a drop in TON. This value starts to increase gradually as the filter-run progresses. Figure 2 depicts this gradual rise.

Table 3. TONs and their percentage change for raw, flocculated and filtered water samples at a direct filtration plant

Figure 1. Variation in TON during a conventional water treatment process

The TON for raw, flocculated and filtered water samples for a direct filtration plant are given in Table 3. Although the TON for filtered water at the direct filtration plant cannot be compared directly to the TON for filtered water at a conventional water treatment plant because of possible differences in such factors as depth and quality of the filtration medium, the results show that the sedimentation process clearly has an effect in the reduction of odour during the treatment process.

Conclusions

- A conventional water treatment plant is better for odour removal than a direct filtration plant.
- Moringa carbon is an effective adsorbent for odour removal in drinking water supplies in Malawi.
- Moringa carbon as an analytical reagent for odour testing can be readily produced in Malawi.
- Odour in drinking water supplies can be readily assessed quantitatively and the test, that does not require expensive glassware, can be incorporated as a process control parameter.

Acknowledgements

This research was funded by the Overseas Development Administration of the United Kingdom. However the ODA can accept no responsibility for any information

Figure 2. Variation of TON as a filter run progresses

Figure 3. Variation in TON during a direct filtration treatment process

provided or views expressed. The authors are also grateful for the technical support provided by personnel from the Lilongwe Water Board and the Blantyre Water Board.

References

Warhurst, A.M., G.L. McConnachie, et al. (1996). The production of activated carbon for water treatment in Malawi from waste seed husks of Moringa Oleifera. Water Sci. Tech. Vol 34, No 11: 177-184.

Warhurst, A.M., G.L. McConnachie, et al. (1997). Characterisation and applications of activated carbon produced from Moringa Oleifera seed husks by single-step steam pyrolysis. Water Research Vol. 31, No.4, 759 - 766.

McConnachie, G.L., V.H. Chipofya, et al. (1996). Activated Carbon from Moringa husks and pods. Reaching the unreached: Challenges for the 21st Century, Proc. 21st WEDC Conf, New Delhi, India, WEDC, Loughborough University of Technology. 91-94.

WEDC (1996) Urban Water Supply Training Programmes at WEDC: 1996-1997 Bulletin. Loughborough University of Technology.

HMSO (1994) The determination of taste and odour in potable waters, Methods for the Examination of Waters and Associated Materials, London, UK.

V. CHIPOFYA, Malawi.
G. McCONNACHIE, UK.
A. WARHURST, UK.
E. PATEY, UK.
H. RIDGEON, UK.