Biofiltration of cyanobacterial metabolites MIB and geosmin as a viable water treatment option

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Biological filtration in SA WTPs

Reservoir → Coagulation → Flocculation → Sedimentation → To sludge treatment and disposal → Filtered water storage

Increased biological activity?

Rapid anthracite-sand filters

Chlorine

Backwash supply sump
- Ammonia
- Fluoride, caustic
Biological filtration at Morgan WTP

- Filter media in place since 1986
- December 2004

Decrease in biological activity?

Geosmin Breakthrough

Filtered water storage ➔ Rapid anthracite-sand filters ➔ Backwash supply sump
- Ammonia
- Fluoride
- Caustic
- Chlorine

Chlorine ➔
Geosmin breakthrough

McDowall et al. (2007), Water 34(7), pp. 48-54
Laboratory scale column experiments
(Morgan WTP sand filter medium)

Ho et al. (2007), Chemosphere 66, pp. 2210-2218
Batch experiments
(Morgan WTP settled water)

Ho et al. (2007), Chemosphere 66, pp. 2210-2218
Isolation of geosmin degrading bacteria
(consortium of three bacteria)

16S rRNA gene Neighbour-joining phylogenetic analysis

Isolation of geosmin degrading bacteria (individual bacterium)

16S rRNA gene
Neighbour-joining phylogenetic analysis
Geosmin degradation by individual bacterium *Sphingopyxis* sp. Geo48

Hoefel *et al.* (2009), *Wat. Res.* 43 (11), pp. 2927-2935
Enhancing biofiltration of geosmin by seeding sand filters with geosmin degrading bacteria
Enhancing biofiltration of geosmin by seeding sand filters with geosmin degrading bacteria

Conclusions

- Chlorine in backwash water of Morgan WTP
  - Full scale evidence of biofiltration for the removal of secondary algal metabolites (T&O compounds)

- Laboratory scale column and batch experiments
  - Validated the full scale removals at Morgan WTP
  - Investigate transient periods for MIB and geosmin
  - Investigated the effect of T&O concentration, cell numbers etc

- Isolation and phylogenetic analysis of geosmin degrading bacteria
  - Better understanding of the organisms responsible for T&O removal

- Enhancing the biofiltration of T&O compounds by seeding sand filter columns
Future work

- Isolation of bacteria involved in the degradation of MIB
- Investigation into the genes involved in the degradation of geosmin and MIB
  - Development of molecular tools for screening WTP sand filters
- Additional laboratory scale investigations into enhancing biofiltration of geosmin and MIB by seeding degrading organisms
  - Pilot scale
Acknowledgements