



THE EFFECT OF pH, COAGULATION AND CHLORINATION ON THE PRODUCTION OF POTABLE WATER FROM EUTROPHIED SURFACE WATER.

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SYNOPSIS

The eutrophic nature of the water in the middle Vaal River gives rise to many operational difficulties and high treatment costs at water purification plants using this source for the supply of potable water. At the Balkfontein plant of Goudveld Water possible causes for the problems were identified. It was decided, from a quality and cost point of view, to evaluate and optimise existing processes and process configurations rather than to investigate the implementation of new and advanced technologies.

The aims of this study were to:

1. Investigate, on bench scale, the effects of pH, dosage and point of chlorine dosing and coagulant type and dosage on;
 - the removal of algae and algal products
 - the formation of trihalomethanes (THMs).
2. Identify from these investigations optimal process conditions of pH, chlorine dosage and dosing point and coagulants for the Balkfontein plant.
3. Verify plant performance, when operating under these conditions, by means of full-scale investigations.

The final conclusions of this study are:

1. Efficient removal of chlorophyll-*a* and algal cells can be obtained by;
 - increasing the coagulant dosage or adding a cationic poly-electrolyte as secondary coagulant.

- applying intermediate chlorination.
 - If pre-chlorination is excluded from the treatment process, increasing the coagulation pH by adding lime results in an increased removal of chlorophyll-*a*.
2. Removal of organic substances is enhanced by replacing pre-chlorination with intermediate chlorination.
 3. Trihalomethanes formation potential (THMFP) is reduced by replacing pre-chlorinating with intermediate chlorination
 4. Increasing the coagulation pH, however, adversely affects;
 - organic removal (measured as DOC) and consequently probably enhances the formation of THMs
 - the removal of some algal species.

SAMEVATTING

Die lewering van drinkwater uit die eutrofe water van die middel Vaal rivier veroorsaak suiweringsprobleme en het hoë behandelingskoste tot gevolg. By die Balkfontein watersuiweringsaanleg van Goudveld Water is moontlike oorsake vir hierdie probleme geïdentifiseer. Daar is uit 'n koste oogpunt besluit om eerder hierdie probleme in diepte te ondersoek en die bestaande prosesse te optimiseer as om die implementering van gevorderde prosesse te ondersoek.

Die doelstellings van hierdie studie was:

1. Om op laboratoriumskaal die uitwerking van pH, chloordosering by verskillende toedieningspunte, asook verskillende flokkuleermiddels en doseringskonsentrasies te toets op die
 - verwydering van alge en alg-produkte en
 - die vorming van trihalometane (THMs).
2. Om by wyse van hierdie ondersoeke die prosesse vir die Balkfontein aanleg te optimiseer met betrekking tot pH, chloordosering en koagulant-keuse en konsentrasie.
3. Om die bevindinge in die praktyk onder normale operasionele omstandighede te toets.

Die belangrikste gevolgtrekking van hierdie studie is:

1. Effektiewe verwydering van chlorofil-*a* en algselle kan verkry word deur:

- óf die verhoging van doseringskonsentrasie van die flokkuleermiddel óf die byvoeging van 'n kationiese poli-elektroliet as 'n sekondêre flokkuleermiddel.
 - intermediêre chlorinering.
 - Die verhoogde pH, wat verkry word deur die toediening van kalk, gee ook aanleiding tot 'n meer doeltreffende verwydering van chlorofil-*a* indien voor-chlorinering nie plaasvind nie.
2. Die verwydering van organiese stowwe word bevorder deur die intermediêre toediening van chloor in plaas van toediening voor koagulasie.
 3. Die potensiaal vir die vorming van THMs word insgelyks verminder indien die toediening van chloor voor koagulasie vervang word met intermediêre chlorinering.
 4. Verhoging van die pH oefen egter 'n negatiewe invloed uit op:
 - Die verwydering van organiese materiaal (gemeet as opgeloste organiese koolstof) en bevorder sodoende moontlik die vorming van THMs.
 - Die verwydering van sekere spesies van alge.

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LIST OF ABBREVIATIONS

DBP	disinfection by-products
DOC	dissolved organic carbon
EOM	extracellular organic matter
IOM	intracellular organic matter
NOM	natural organic matter
NTU	nephelometric turbidity units
SUVA	specific UVA
THM	trihalomethanes
THMFP	THM formation potential
TOC	total organic carbon
TOX	total organic halogens
TTHMs	total THMs
UOFS	University of the Orange Free State
UVA (UVA ₂₅₄)	ultraviolet absorbance

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