

prognoses van de hardheid van het onttrokken grondwater mogelijk; 6. preventieve maatregelen ter verlaging van de hardheid van het onttrokken grondwater zijn mogelijk. Toepassing van deze maatregelen vraagt maatwerk, afgestemd op de al of niet aanwezigheid van kalk en het landgebruik.

Verantwoording

Voorliggende publicatie vormt een onderdeel van het door VEWIN aan Kiwa opgedragen onderzoeksprogramma 1993-1997. De voor de uitvoering van het onderzoek benodigde gegevens zijn beschikbaar gesteld door de waterleidingbedrijven WML, WMO, WOB en WOG.

De heer B. van der Grift, student Geochemie aan de Rijksuniversiteit Utrecht, heeft een waardevolle bijdrage geleverd aan dit onderzoek.

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Vuiluitworpreductie Leeuwarden

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wordt gestreefd naar een kostendekkend rioolrecht.

Vervanging van het bestaande stelsel vormt de grootste post die uit het rioolrecht bekostigd moet worden. Investerings in het stelsel voor vuiluitworpreductie vormen ondanks de forse investeringsbedragen niet de overheersende factor in de hoogte van het rioolrecht. Mede door dit inzicht in de opbouw van het rioolrecht is draagvlak ontstaan om de verbeteringsmaatregelen uit te voeren. Doordat al voor-

afgaand aan de afronding van het technische deel de bestuurlijke besluitvorming heeft plaatsgevonden kan direct met de voorbereiding van werken worden gestart. Het rioolrecht zal in de gemeente Leeuwarden in enkele jaren tijd stijgen tot circa f 275,- voor een gemiddeld huishouden. Een zeer acceptabel bedrag voor een goed functionerend rioolstelsel!

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Summaries

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concentrations of methane in the groundwater, the biological removal of ammonia, normally taking place in the sand filters, is less effective. Experience has shown that at low methane concentrations in the water feed, the ammonia removal improves. Furthermore high methane concentrations have shown an increased level of *Aeromonas* bacteria. In order to improve the efficiency of the purification in the sand filters and to prevent growth of *Aeromonas* bacteria, it is better to remove the methane, before the biological purification step. Removal of methane from raw water can be accomplished by intensive aeration/degassing techniques. Cascades, tower- and plate aeration, vacuum degassing and high pressure spraying nozzles are possibilities to achieve this goal. On an experimental scale NV WZHO has researched the possibilities of high pressure spraying nozzles. Results of these experiments have shown that high pressure spraying nozzles remove, under optimum conditions, up to a maximum of 95% of the methane, present in the raw water feed. When applied under continuous operation an average of 90% removal is expected to be achieved. An additional positive effect of high-pressure spraying nozzles (compared the presently used lowpressure spraying nozzles) is the improvement of water distribution over the filterbed area. The investment and operation costs of applying high-pressure spraying nozzles are comparable to other intensive degassing techniques like for instance vacuum degassing

H₂O (30) 1997, nr. 7; 220

TH. G. J. WITJES, A. G. POSTHUMUS, P. HOLTES and A. MAK:

Possible measure to decrease drought damage in 'Zwanenwater'

'Zwanenwater' is an international acknowledged dune wetland in the north-west part of the Netherlands. Through the difference between the

phreatic ground water level in the dune wetland and the surface water level in the surrounding polders, a downward seepage from the dune to the polders has caused a serious drought damage in the eastern valleys of 'Zwanenwater'. Witteveen+Bos has studied several possible measures to decrease the downward seepage. A ground water computer model is developed to compare the effectivity of the measures. Special attention took the water supply for the bulb-growing in the surrounding polders.

H₂O (30) 1997, nr. 7; 226

R. S. VAN DER VELDE, S. GEENEN, W. BOSCH and K. LAMSMA:

New policy for reducing the pollutant load caused by sewer overflow in Leeuwarden

The municipality of Leeuwarden, a medium sized town in the northern part of the Netherlands, has recently formulated a new policy towards reducing of the pollutant load caused by (combined) sewer overflow. The developed measures come up to the requirements as set by the local water board. The proposed measures are problem oriented. This implies extensive measures in canals where the water quality highly depends on sewer overflow. On other locations, it is decided no alterations are necessary in the near future. The main items that are dealt with are (combined) sewer overflow and measures to reduce this, development of new sewer catchments, and the creation of retention basins. Attention is paid to the financial consequences and the planning of activities in time.

H₂O (30) 1997, nr. 7; 228

C. G. E. M. VAN BEEK:

Hardness of groundwater: prognoses and preventive actions

A high hardness of drinking water is annoying for the consumer. Moreover a high hardness often coincides with a high copper solubility, which is detrimental for the environment. In order to meet these complaints, water works put into service water conditioning, in this case softening. On many well-fields the hardness of the abstracted water increases. Information about this increase is of importance for the installation and the dimensioning of softening-plants. Prognoses are here an essential help. In this paper the results of ongoing research are presented. Many sources (input from the surface) and processes (interaction with the solid soil matrix) contribute to the hardness of groundwater. For the purpose of prognoses it appears necessary to classify well-fields on the base of the presence of limestone in the soil. If the soil does not contain limestone, the hardness will be determined by a hardness-balance: the difference between in- and output of hardness leaches to the groundwater. In case the soil contains limestone, the hardness will be determined by an acid-balance: leached acid will be neutralized by the dissolution of limestone, originally present in the soil. The most important contributions of the hardness- and the acid-balance are known. Therefore rough prognoses for the hardness of the abstracted groundwater are already possible. Moreover preventive actions to decrease the hardness can be considered as well.