



TRENDS IN ADVANCED WASTEWATER TREATMENT

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ABSTRACT

The paper examines the present trends within wastewater handling and treatment. The trend is towards the extremes, either local low-tech treatment or centralized advanced treatment plants. The composition of the wastewater will change and it will be regarded as a resource. There will be more emphasis on the sustainable aspects, on green accounting and on the health aspects. © 1997 IAWQ. Published by Elsevier Science Ltd

KEYWORDS

Wastewater treatment; wastewater composition; strategic trends.

INTRODUCTION

The wastewater treatment market is under strong development. On one hand there is the technological development of advanced processes, on another hand the changes in attitude towards the environmental treatment technologies. Legislation and control are getting more strict, and developments in society, result in changes in the composition of the wastewater. Until recently environmental technology was not expected to live up to similar standards as traditional industrial enterprises. To get a wastewater treatment plant or a landfill as a neighbour is regarded even more serious than if it was a traditional industrial plant.

The various pressures result in development trends for the wastewater treatment processes of tomorrow. These trends are discussed below.

THE 10 TRENDS

There are many changes in the society that affect wastewater treatment. Some main factors and trends are discussed below. In order to limit the use of paper for this publication, only 10 trends are dealt with. These are:

- Changes in wastewater
- Wastewater is a resource
- Sustainability
- Industrialization
- Clean technology
- Small is beautiful

- Ecotreatment
- From criteria to control
- Waste product design
- Public Health

CHANGES IN WASTEWATER

Wastewater composition changes in societies under development. Economic and cultural changes influence wastewater composition. The per capita BOD load and the wastewater temperature increase with increasing GNP. Legislation can change the composition, like phosphorus-free or NTA-containing detergents. New industrial products bring their own composition of wastewater. Water shortage will reduce the wastewater volume and increase the concentrations, and so will sewer rehabilitation. The main factors that influence the wastewater composition are:

- Culture (olive oil, milk)
- New industrial products (LAS, phthalates)
- Water savings
- GNP
- Detergents (phosphorus, zeolites, NTA)
- Reuse in households
- Storm water handling
- Sewer network quality
- Household waste technology (garbage grinders, urine separation)
- Legislation (metals)

Currently changes are occurring for most of these factors, and this will continue in the near future. Thus we can expect future changes in wastewater composition. With the recent understanding that the detailed wastewater composition has strong influence on the processes in the treatment plants (Henze *et al.*, 1995a, b) future changes are important.

WASTEWATER IS A RESOURCE

Wastewater should be and is increasingly regarded as a resource for chemicals which can be used in the treatment. Some chemicals can be directly present, like acetic acid. Others can be produced from the wastewater. Manipulation of wastewater composition is an important aspect of modern wastewater treatment technology (Henze and Harremoës, 1992). By changing the wastewater composition, the process performance will change, as shown by the new modelling approaches, for example the Activated Sludge Model No.2 (Henze *et al.*, 1995c). Wastewater is also changed/manipulated during sewer transport – in most cases in an unplanned way. Examples of the use of wastewater as a resource are:

- * Carbon for denitrification from raw wastewater
- * Fatty acids for Bio-P
- * Hydrolysis, production of easily degradable carbon
- * Biogas production
- * Use of industrial effluents as carbon source for denitrification

The heat content in the wastewater can also be used, but this is not widespread yet.

SUSTAINABILITY

The handling and treatment of wastewater uses various resources. Future attention will be on the use of these resources and on the impact on the environment from the wastewater treatment plant.

Reductions in

- * area
- * energy
- * receiving water impact
- * sludge production
- * odours
- * microbial contaminants

can be significant future development paths. Processes with low resource consumption per capita and low impact on the environment will be favoured. The resources do not have identical importance in all cases, thus area consumption can be the most important in some cases, while energy consumption can be the determining factor in other cases.

WASTEWATER TREATMENT PLANTS ARE INDUSTRIES

A wastewater treatment plant is not at present regarded as an industrial plant. Many treatment plants would never be accepted if they were industries, because of their pollution and their use of resources. To treat the plants as industries, will improve efficiency, put more emphasis on the raw material (the incoming wastewater) and more on the product (the emissions of air, solids and water).

CLEAN TECHNOLOGY AT TREATMENT PLANTS

The use of cleaner technology has until now been restricted to industries. Wastewater treatment plants should be handled in a similar way. The selection of processes has until now been based on low cost, not on the impact on the environment. It is contradictory that treatment plants, which are seen by the public as units that clean the environment, are heavily polluting the environment through odours, sludge production and wastewater production. Although the wastewater is cleaned it is still polluting the environment. Some chemicals used at treatment plants contain pollutants in significant amounts, e.g. heavy metals in precipitants for phosphorus. The use of green accounting in treatment plants will soon become a demand.

SMALL IS BEAUTIFUL

There is a trend towards local handling of pollution; centralized handling is believed to be too expensive with respect to resources like energy, area and money. From a total view it has not yet been demonstrated which type of treatment is the optimal. The discussion on private waste treatment versus public treatment has its parallel in the transport sectors, where most people agree that public transport is the less resource consuming method of moving the population around.

ECOTREATMENT

There is a tendency towards the use of ecological treatment processes. No definition exists as to what this is, but those marketing some wastewater treatment technologies claim that they are ecological. It seems that if there is a plant at the plant, then the treatment is considered ecological and natural. Bacteria and fungi are not considered to be ecological by many people, unless the bacteria are used for anaerobic biogas treatment.

FROM CRITERIA TO CONTROL

Effluent criteria are good, but effluent control is better. In many parts of the world, the criteria were formulated long ago, but have never been enforced. Efficient control can significantly change the function and operation of wastewater treatment plants. In Denmark the risk of being sentenced to one year in jail has increased the safety factors used in design and operation.

WASTE PRODUCT DESIGN

The air, solid waste and liquid discharges from wastewater treatment plants should be regarded as products. These should have an optimal composition in relation to their further handling, and not only optimal for the treatment plants or minimum in amounts. An example is aluminium versus iron as precipitant in phosphorus removal. If the sludge is used for agricultural purposes, then iron is the optimal precipitant, due to the plant availability of the iron phosphates.

PUBLIC HEALTH

Wastewater handling and treatment was originally done in order to improve public health. This important feature has been partly forgotten. There will be more focus on the health aspects of wastewater handling and treatment in the future. What are the microbial emissions from treatment plants and how do they affect our health? Many of the emerging technologies will be tested and meet their Waterloo due to this important factor. Human waste is not a harmless substance. It is toxic to the environment (Ono *et al.*, 1996) and contagious. The microorganisms in aerosols, sludge and in the treated wastewater will get more attention in the future.

CONCLUSION

The trends in wastewater handling and treatment technology are towards the extremes, either local low-tech treatment or centralized advanced treatment plants. The composition of wastewater will change and it will be regarded as a resource. There will be more emphasis on the sustainable aspects, on green accounting and on the health aspects.

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