

# Quality Control in Wastewater Treatment

Light microscopic analysis of activated sludge



Seeing beyond

Wastewater contains a large number of different microorganisms such as bacteria, fungi and protozoa, which, due to their specific metabolic activity, break down the organic components of the wastewater. The diversity of species, which must be regularly checked with the aid of microscopes, is crucial in this respect. The wastewater treatment plant operator can thus identify indicator organisms and make statements about the decomposition capacity of the plant.

## Introduction

Treating wastewater or sewage to produce clean water is the top priority in the work of a wastewater treatment plant operator. If contaminated water is discharged into running waters, this results in a threat to people, the environment and nature. The majority of wastewater treatment takes place in wastewater treatment plants and there in several stages. In addition to physical and chemical processes, biological wastewater treatment using microorganisms plays a crucial role.

## Microorganisms as natural helpers

For biological wastewater treatment, an activated sludge tank is used. Carbon-based pollutants are broken down through the targeted use of microorganisms by making the pollutants the food source for different microorganisms, the biocoenosis. The microorganisms metabolize the carbon compounds and ultimately leave behind inorganic end products. In the activation tank, the wastewater is continuously aerated so that the decomposition of the microorganisms can take place reliably. If all living conditions are optimal, the

decomposition capacity of the biocoenosis runs at full speed. However, microbial decomposition capacity is susceptible to disturbances. For example, a lack of oxygen impairs the decomposition capacity of aerobic microorganisms. Temperature fluctuations, shock loads, overly high concentrations of ammonium and oxy-fatty acids and many other factors can also lead to disturbances in the wastewater treatment process.

## Microscopy in wastewater treatment plants

The aim is to cultivate as active and stable a community of microorganisms as possible in the sedimentation tank in order to ensure efficient and cost-effective biological wastewater treatment.

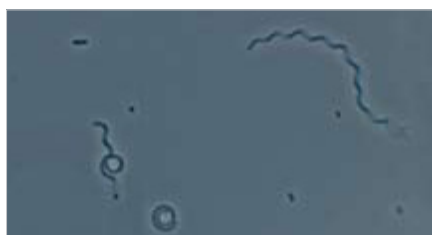
By means of microscopic analysis of the activated sludge it is possible for the wastewater treatment plant operator to estimate the decomposition capacity of the plant and to respond to any undesirable developments. Indicator organisms show the current situation of the treatment performance: if the plant is working optimally, *Vorticella convallaria*

(cover picture), for example, occurs in high density. If, for example, the microscopic image shows an accumulation of spirochetes, this often indicates a lack of oxygen. The identification of spirochetes gives the wastewater treatment plant operator the possibility of an early oxygen supply to create the conditions for an ideal biocoenosis in the sludge. If, for example, the microscopic image shows a critical mass of *Microthrix parvicella*, there is a risk of undesired bulking sludge formation.

In practical handling, a drop of activated sludge is placed on a microscope slide and covered with a cover glass. Since the majority of the microorganisms in the activated sludge are colorless, a microscope with phase contrast is the method of choice. If fluorescent dyes are used to label specific organisms, they can be made visible using fluorescence microscopy.



**Image 1** *Microthrix parvicella*  
(bulking sludge generator), phase contrast  
Source: D. Eikelboom, [www.asissludge.com](http://www.asissludge.com)



**Image 2** Freshwater spirochetes,  
phase contrast



**Image 3** *Cyathomonas* (colorless flagellate),  
phase contrast

## Summary

Microscopic activated sludge analysis makes a significant contribution to the assessment of biological decomposition processes. The information provided by the microscopic image allows conclusions to be drawn regarding the composition and stability of the biocoenosis of the microorganisms and can therefore act as an early warning system for any undesirable developments in biological wastewater treatment. A microscopic examination of the sludge (activated sludge process) or the biofilm (biofilm process) is an indispensable instrument for assessing the performance of wastewater treatment plants.

## Recommended microscopes



### ZEISS Primo Star

- Phase contrast (415500-0055-000)
- Camera adapter (415500-1810-000)
- ZEISS Axiocam 208 color (426570-9000-000) or alternatively camera tube (415500-1402-000) with integrated 5 MP HD streaming camera.

The Primo Star camera option makes it possible to document and transmit the bacteria image to analytical laboratories.

Optional:

- Fluorescence intermediate tube equipped with filter set 09 and 470 nm LED (415500-1823-000)
- Transport and storage case (415500-1827-000)

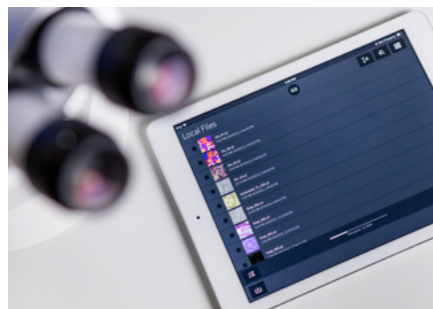


### ZEISS Axiolab 5

- Complete package 490980-0002-000 with transmitted light brightfield and phase contrast, phototube, camera adapter and ZEISS Axiocam 208 color

Optional for the analysis of fluorescence-labeled bacteria

- Complete package 490980-0003-000 with LED-based multi-channel fluorescence in 385 nm, 470 nm and 565 nm



### ZEISS Labscope

The Labscope Imaging App for Windows and iOS allows you to easily and quickly record images and videos, easily insert annotations and perform measurements. You can share images and videos via an HD monitor, projector, e-mail, social media or cloud services. Labscope is available for free download in the App Store (iOS version) and on the ZEISS web page (for Windows).

*“The activated sludge process is used on a large scale for the treatment of wastewater. Process stability and process quality strongly depend on the composition of the biocoenosis in an activated sludge plant. Operational problems such as bulking sludge or foam formation occur when the “wrong” microorganisms in the sludge take over. Microscopic sludge analysis is therefore absolutely essential for process monitoring and stable plant operation.”*



### Dick H. Eikelboom

*Over 40 years of involvement in the field of activated sludge analysis. Author of guidelines, reference books and other materials on the topic of activated sludge analysis. Founder of [www.asissludge.com](http://www.asissludge.com), Netherlands.*



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