

# MONITORING OF INTACT CELLS OF ACTIVATED SLUDGE BY ELECTROCONDUCTIVITY

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## ABSTRACT

Electrophysical properties of activated sludge cells researches present the theoretical interest and practical applications in biological waste water treatment.

The method of differential measurements of biological cells suspension electroconductivity during sedimentation process in modified environment was developed. Using this method, we can determine concentration of intact cells and accordingly monitor the process of water treatment.

## KEYWORDS

Concentration of intact cells; Modification of environment; Activated sludge; Electroconductivity; Differentiation of suspension properties.

## 1 INTRODUCTION

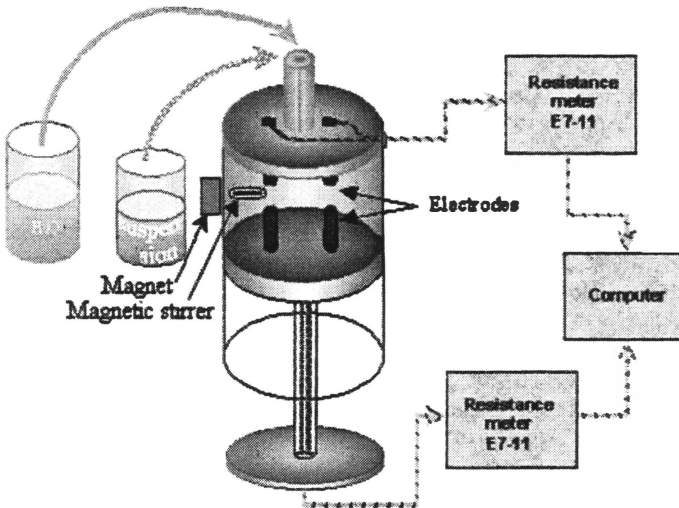
Activated sludge is the fundamental bioreagent in sewage water purification. Native cells of activated sludge situate in isopolarized state with surrounding environment that gives specific troubles to control the intact state of cells.

When cells are in isopolarized state the effective bulk conductivity of cell suspension is equal to disperse medium conductivity because of surface conductivity influence of cells [1]. These cells are able to change the concentration of their intracellular fluid, when amount of electrolyte changes in external environment [2, 3]. In that case, the conductivity of suspension practically an independent on the concentration of microorganism cells.

The method of differential measurements of biological cells suspension electroconductivity during sedimentation process in modified environment was developed.

## 2 MEASUREMENT OF ELECTROCONDUCTIVITY OF SUSPENSION.

The electroconductivity of activated sludge suspension was measured using the original home-made instrument, which consist of the circular container with two pairs of electrodes at the top ( $\gamma_t$ ) and in the bottom ( $\gamma_b$ ) of the cylinder (see *Figure 1*), on a frequency 1 kHz, at temperature 293 K. A set of measurements of that system electroconductivity was carried out as soon as suspension was mixed with distilled water in different proportions and after 10 minutes of sedimentation. Suspension was agitated by a plastic-coated magnetic stirrer, which was placed inside of container, and by magnet, which was placed around of container.



*Figure 1. Measuring device.*

Resistance ( $\rho$ ) was measured by resistance meter, then electroconductivity ( $\gamma$ ) was calculated by this way:  $\gamma = 1/\rho$ .

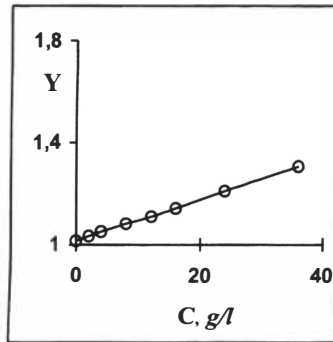
### 3 RESULTS OF MEASUREMENTS

Measurements of Electroconductivity were carried out to determine the concentration dependence of measuring system response in case of constant dilution of suspension by distilled water at different concentrations. The concentrations of cells were defined by weight analysis. Results are presented on *Figure 2*.

By the experiment data it was obtained that the difference between electroconductivity of sediment and liquid phase of suspension  $((\gamma_b/\gamma_l)-1)$ , which were measured after 10 minutes of sedimentation, is proportional to the concentration of cells ( $C_c$ )

$$((\gamma_b/\gamma_l)-1) = a \cdot C_c, \quad (3.1).$$

The constant 'a' depends on the features of electric charge distribution in biological cell and on the parameters of measuring cell. It is determined during calibration of instrument by standard suspensions of activated sludge.



*Figure 2. The concentration dependence of measuring system response,  $Y = \gamma_b/\gamma_l$ .*

### 4 INACCURACY OF MEASUREMENTS

Inaccuracies of measurements were estimated by statistic method, comparing results of electrophysical measurements and weight analysis.

- Inaccuracy of suspension sample picking is  $E_s = 5,8\%$ ;  $E_s = (\Delta W/W_m)100\%$ ,  $\Delta W$  - the confidence interval,  $W_m$  - the average concentration of suspension in the sample. This factor we should take into account twice, because we use weight analysis.
- Inaccuracy of dilution repetition factor is  $E_p = (1-2)\%$ ;
- Inaccuracy of thermostating is (1-15)%.
- Inaccuracy of other factors (like sand, feces, and other solid particles, which can get into the sample) don't make contribution to response of the system. This is the difference between results of current method and method of weight analysis.

Total inaccuracy:  $\Delta \cong (2E_c^2 + E_p^2 + E_r^2)^{1/2} \cong 9,2 \%$ .

## 5 MANUFACTURING TESTING

Inprocess testing of developed method was executed on the airing station of waste water in Saint-Petersburg in connection with estimation of oxygen consumption biological coefficient.

From this measurements it is following that intact cells of activated sludge are absent in the retention tank of primary sedimentation reservoirs and in the inle chamber, but the concentration of biomass is varying in the range from 8 to 13 kg/m<sup>3</sup> in aerotanks. These data are well conformed with other methods of analysis (e.g. weight analysis).

## 6 CONCLUSIONS

- Electrophysical phenomenon of differentiation of solid and liquid phase properties during sedimentation of diluted suspension was experimentally discovered.
- Simple methods and devices of differential measurements of electrophysical properties of biosystem were developed.
- The difference between electroconductivity of sediment and liquid phase of suspension, measured after 10 minutes of sedimentation, is proportional to the concentration of cells.

Biological waste water treatment is concerned with dynamic of ion-exchange processes between cell and medium. These processes can be investigate by method and device presented here. We should also note that several works about kinetic and structural properties of water systems could be very useful for these kind of investigations [4-7].

For example, the method of environment modification could be use to investigate blood cells (erythrocytes, leukocytes, platelets), which state is depend on the environment toxicity.

## 7 ACKNOWLEDGEMENTS

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