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Environmental pollution

EFFECT OF THE DBS DETERGENT* ON OXYGEN CONCENTRATION IN WATER

WPŁYW DETERGENTU DBS* NA ZAWARTOŚĆ TLENU W WODZIE

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Effect of DBS detergent on oxygen diffusion out of and into water with no or 9°/$_{oo}$ NaCl was tested. Concentrations of detergent used were 5; 50 and 250 mg/l SA. Oxygen content was measured after 24 h by the Winkler's methodd; in observations up to 10 days oxygen pressure was measured with Plastomed 305 apparatus. There was no direct effect of detergent present in water on its oxygen content no matter it there were carp juveniles or no fish at all.

INTRODUCTION

According to many communications it is quite clear for detergents to be toxic to organisms living in waters (Bardach, et al. 1965; Cronin and Flemer, 1967; Eisler, 1965; George, 1970;, Granmo, 1971; Abel, 1974). A toxic effect of detergents on fishes was noted during surveys on fish behaviour (Bardach et al., 1965; Korpela, 1969 as well as surveys of tissue enzymes e.g. in gills, serum or brain (Jurkowski 1977; Lundhal, a Cabridence 1978; Jurkowski et al., 1979).

Aside its toxic effect on organisms living in water, detergents are irreplaceble as cleansers in households, industry (Anastasiu and Jelesocu, 1973) and also for crude oil lickeage removal (Smith, 1968) although some of detergents are more toxic for animals, than crude oil is (George, 1970).

High amounts of surface-active agents get, from rivers, into gulfs waters, presenting a serious risk for inhabiting organisms (Drewa et al. 1975; Gramno, 1971; Żmudziński,

* Sodium dodecylbenzenesulphonate (DBS)

1983). Although recently production of detergents less toxic for water organism has been started (Swedmark et al., 1973) nevertheless "traditional" ones are to be used for many years, yet.

Among many data concentrating the toxic effect of surfactants, there are only few dealing with effect of physical agents on detergents toxicity; with few elder data suggesting detergents to decrease the oxygen content in water (Cronin and Flemer, 1967; Korpela, 1969). Our earlier results (Jurkowski, 1979) conducted on the perch fry, suggested the above to be a false statement, however it was found purposefull to test an effect of detergent on diffusion of oxygen into "fresh" and saline waters with and without organisms within these water.

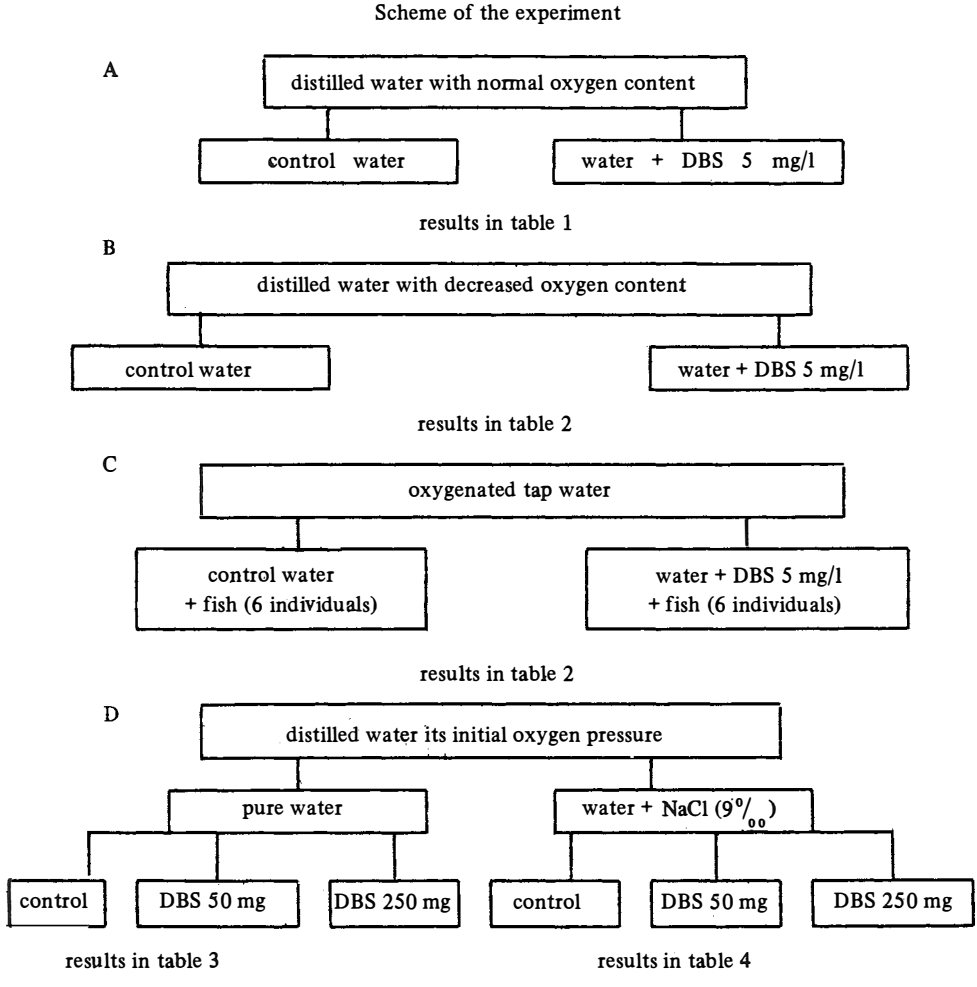

Fig. 1. Scheme of the experiment

A rather common substract for production of many washing preparates in Poland is sodium dodecylbenzenesulphonate (DBS), toxic effect of which is well known (Jurkowski, 1977, Jurkowski et. al. 1979), that was why that detergent was chosen for the experiment.

MATERIAL AND METHODS

The experimental scheme is presented on Fig. 1. The DBS detergent was obtained from the Chemical Plant in Gdańsk. Fry of carp used had 20 to 50 g of weight. Oxygen concentration was measured by the Winkler's method (experiments including fishes as well as 24-h experiments with no fish). In the ten 24-hour experiments pressure of oxygen in water was measured with Plastomed 305 apparatus. All the reagents used were produced by the Polish Chemicals – pure for analysis. Experimental vessels were either 21 in volume and 154 cm^2 in diameter (experiments with no fish in it) or 51 in volume and 576 cm^2 in diameter (experiments with fishes).

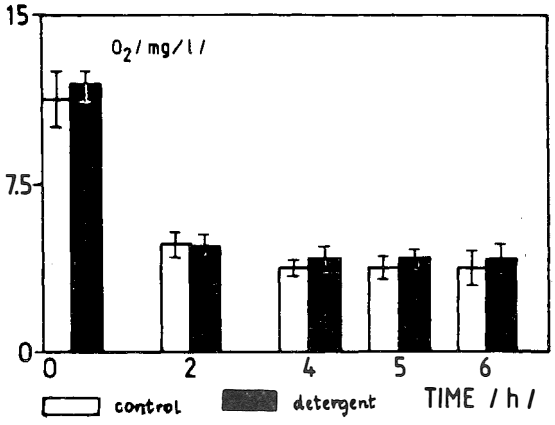

Fig. 2. Rate of oxygen drop in water with fishes

Fish fry was kept in settled, oxygenated tap water (Fig. 10), while other experiments were carried on in settled, distilled water (Fig. 1A and D) distilled water partially oxygen free (Fig. 1B) or in distilled water with 9g NaCl/l. Following concentrations of detergent were applied:

5 mg/l SA – for fish and 24-hours experiments and

50 mg/l and 250 mg/l Sa – in ten – 24-hours observations.

Measures were taken after collecting water samples from the bottom, in three repetitions. Results presented represent average value ± standard deviations.

RESULTS AND DISCUSSION

According to Korpela's results (1969) there was 13.4 mg of various detergents/l of Helsinki municipal sewages, of which, after purification, 2 mg/l got into marine waters. In 1956, contamination of the USA rivers with detergents ranged from 0.1×10^{-3} to 0.5×10^{-3} kg/m^3 (Bardach et al., 1965) reaching 40×10^{-3} kg/m^3 in 1974 (Abel, 1974). Due to the data for the Dead Vistula River, there were seasonal fluctuations in detergent contents; for example in 1975, noted differences oscilated between 1.69×10^{-3} and 2.64×10^{-3} kg/m^3 (Drewa et al., 1975) Although there were no, more actual, data available, presumably since than, concentration of detergents haven't decreased, that was why doses of detergent applied in the experiments were relatively high and equal to 50 and 250 mg/l SA. Testing relations between an oxygen concentration and oil impurities in waters, Otremba and Kaniewski (1983) proved there to be one between oxygen content and an air-water contact surface with the oxygen decreasing rate being particularly fast within the first 10 days of the experiment (decrease in initial oxygen content by 50%).

In the present experiments, beside the 24-hours ones (Tab. 1 and 2) the ten-days experiments were conducted, however, according to results (Tab. 3 and Tab. 4) no essential changes in an oxygen pressure were observed in waters, both, with and without NaCl. Experiments were conducted in containers with a small air-water contact surface, as to get thicker layer of detergent on the surface, just to make an oxygen diffusion more difficult.

Table 1

Time (hours)	Oxygen content (mg/l)	
	control	detergent
0	11.6±0.7	11.6±0.7
6	11.9±0.8	12.2±0.8
24	11.5±1.2	11.8±0.7

Table 2

Time (hours)	Oxygen content (mg/l)	
	control	detergent
0	8.0±1.0	8.0±1.0
24	10.7±1.1	11.5±0.7

Table 3

Time (hours)	Oxygen pressure (mm Hg)		
	control	detergent	
		50 mg/l SA	250 mg/l SA
0	153 ± 5.2	153 ± 5.2	153 ± 5.2
24	148 ± 2.3	149 ± 5.0	149 ± 1.1
48	146 ± 1.1	140 ± 5.4	143 ± 3.9
96	149 ± 4.7	150 ± 2.2	142 ± 5.7
168	153 ± 4.8	155 ± 1.1	144 ± 8.3
216	146 ± 2.8	152 ± 4.3	144 ± 7.5
240	147 ± 3.7	142 ± 4.6	138 ± 7.6

Table 4

Effect detergent on oxygen content in saline water (9g NaCl/l)

Time (other)	Oxygen pressure (mm Hg)		
	control	detergent	
		50 mg/l SA	250 mg/l SA
0	147 ± 2.6	154 ± 5.5	152 ± 3.2
24	145 ± 1.7	152 ± 4.2	150 ± 4.3
48	138 ± 5.3	145 ± 3.7	122 ± 6.8
96	150 ± 2.8	150 ± 5.2	136 ± 5.6
168	154 ± 2.3	151 ± 2.2	143 ± 5.7
216	146 ± 3.7	151 ± 4.3	144 ± 3.9
240	135 ± 3.2	147 ± 5.4	130 ± 6.9

Sensitivity of fishes and other water organisms towards detergents depends, in between, on type of deteregent, its concentration and organism species (Thatcher, 1966, George, 1970, Swedemark et al., 1971) itself. Toxicity of detergents depends, to a high degree, on its chemical structure, water pH and hardness, oxygen concentration and temperature of water (Eisler, 1965; Hohanson and Smith, 1971). In the experiments with fishes, oxygen decreasing rate, in both containers was alike (Fig. 2), however fishes within the control container survived while these within the container with detergent started to die. (Experiment ended when three fishes died in water with detergent. Obtained results indicated the direct cause of the fishes death was other then lack of oxygen in the water. Simmilar results were obtained in experiments with no fish. Yet indirect effect of detergent on oxygen concentration in water, through eutrophication process, for example, can't be excluded. (Cronin and Flemer, 1967; Zbytniewski et al., 1975). Observations of Kaniewski and Otremba (1983), however, concerning pollution with oil-derivatives, proved there to be an increase in oxygen concentration in polluted waters.

According to the obtained results it can be stated the tested detergent has no direct effect on the oxygen concentration in water.

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WPŁYW DETERGENTU DBS* NA ZAWARTOŚĆ TLENU W WODZIE

STRESZCZENIE

Wykonano oznaczenie tlenu metodą Winklera w wodzie z dodatkiem detergentu DBS po 24 godzinach, w eksperymencie z narybkiem karpia oraz bez ryb. Użyto detergent w stężeniu 5 mg/l SA. Stwierdzono brak różnic w zawartości tlenu w wodzie bez detergentu i z detergentem, jakkolwiek w tej ostatniej ryby zaczęły snąć po 5 godzinach doświadczenia. Wykonano również eksperymenty bez ryb z dużymi stężeniami detergentu 50 i 250 mg/l SA prowadząc pomiary prężności tlenu aparatem Plastomed 305 do 10 dób w wodzie bez soli i zasolonej w ilości 9‰. Także w tych doświadczeniach nie stwierdzono istotnych różnic w zawartości tlenu w badanej wodzie.

Uzyskane rezultaty pozwalają stwierdzić, iż obecność detergentu w wodzie nie wpływa w sposób bezpośredni na zawartość w niej tlenu.

* dodecylobezenosulfonian sodowy

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