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THE ROLE OF BOTTOM DEPOSIT IN THE EFFECT OF PHOSPHORUS INACTIVATION METHOD AS A PART OF THE COMPLEX RESTORATION OF DEGRADED LAKE

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The study was conducted in Długie Lake (area 26.8 ha, max. depth 17.3 m), localized in the north-eastern Poland (Masurian Lake District), in Olsztyn city. That water body was one of the most polluted lakes in Poland. The reason of such high pollution of the lake was an inflow of raw wastewater. In the period of 1956-1976 daily amount of sewage flowing to the lake was ca. 350-400 m^3 per day. The total volume of sewage, which was loaded into lake during 20 years period was equal 1.5 of total lake water volume. The cut off the sewage inflow didn't cause the improvement of the water quality – the lake changed its trophic status from saprotrophy into hypertrophy. Then it was necessary to implement the complex renovation procedure in order to decrease very high phosphorus level in the lake water and to limit massive P internal loading. Two technical restoration methods were used for the improvement water quality – the first method was artificial aeration with thermal destratification of lake water (1987-2000); the second – phosphorus inactivation method using aluminum coagulant PAX 18 (2001-2003).

The presented analysis concerns the multiannual changes in bottom zone, caused by implementation of the second technical procedure ie. phosphorus inactivation method; before (1999), during (2001-2003) and after termination of restoration procedure (2004-2013).

The bottom sediment samples were taken in the one station, located in the deepest point of the lake. The undisturbed sediment cores were taken using Kajak's bottom sampler and the over bottom water – with Ruttner apparatus (1 m above the bottom). The 10-cm water layer above the sediment core was decanted and treated as the near-bottom water. The interstitial water was obtained after centrifugation of top 5 cm sediment layer (3000 rpm, t=20 min).

The analyzes of physical and chemical properties of lake water, near-bottom and interstitial water were applied according to Standard Methods (1999) and Hermanowicz et al. (1999) and included: phosphorus forms, water transparency, dissolved oxygen. The phosphorus forms were measured (mineral P, total P and organic P).

Water transparency was obtained from Secchi disc (d=30 cm) visibility measurements.

Dissolved oxygen was measured by Winkler method (Hermanowicz et al. 1999).

The phosphorus fractionation procedure was made according to scheme, proposed by Rydin and Welch (1999).

The obtained results showed that using the P inactivation method caused the improvement of the lake water quality and confirmed that bottom sediment acted as effective trap for phosphorus. The NaOH-rP fraction quantity (P bound mainly with aluminum) increased 100% above within ten years since beginning of restoration procedure, comparing to control year (1999). The applied lake renovation method was reflected in the decrease not only in P concentration, but also in the other parameter e.g. water transparency. The increase of this parameter values was the effect of the reduction of phosphorus level in the water, which undoubtedly led to a lower phytoplankton biomass. The study revealed that positive environmental changes, caused by applied recultivation method can be noticeable through long-term period of time (10 years) and the P inactivation method can give multiannual effect of the water quality improvement. Presented research confirm the thesis, that P inactivation method can significantly modify sediment P sorption capacity, this effect is long-term and effective in the limitation of the internal loading phenomenon in the lake.