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SOME RESULTS OF THE CHEMICAL INVESTIGATIONS OF THE RIVER TISZA IN 1974

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Abstract

The paper is evaluating some water quality components of the supplying water current from the point of view of the future Kisköre Reservoir, supposing that till 1978 no important changes occur, except for the extraordinary water pollutions.

In addition to reporting on the connections discovered on the basis of the results of investigations carried out for a rather long period (about one and half years), we are dealing also with the problems of homogeneity, the optimum sampling point, and frequency.

Introduction

One of the determinants of the water quality in the future reservoir will be undoubtedly the supplying water current. We are attempting, therefore, by evaluating the present data appropriately, to describe the physical and chemical processes that take place in the river reaches investigated and may in the future exert a decisive influence on the water quality in the Tisza and the Reservoir.

The chemical and biological changes induced by the Kisköre damming up in the middle Tisza region since April 1973 (ÁDÁMOSI *et al.* 1974), have raised, as compared to the investigations in the former decades, more problems and it will be an interesting task of the next years to reply to these.

Characterization of the area investigated
Material and method

The length of the Tisza region investigated by us is about 70 km. Samplings were carried out from the current-line of the river between Tiszacsege and Tiszaroff (Fig. 1), at Kisköre weekly, at Tiszacseg, Tiszafüred, Tiszaderzs, and Tiszaroff fortnightly.

There are considerable differences to be found in the structure of river bed in some places. The profile of the sampling point at Tiszacsege is characterized by a smaller depth and larger breadth, while above Kisköre we may notice a larger depth and smaller breadth in case of identical water outputs, as depended on the damming up, as well.

We have sampled at the limit of transparency, but for investigating the stratification we have taken samples by means of a semi-rotary pump from various depths. Transparency was measured with SECCHI's disk.

The chemical investigations were carried out with the Uniform Methods of Water Investigation of COMECON (typ. Sartorius SM 11 306). The elaboration took place on the day of sampling.

The water output could be determined at several points after surveying the river-bed with speeds measured in various depths. The water quantity flow through the constructive works was always at our disposal.

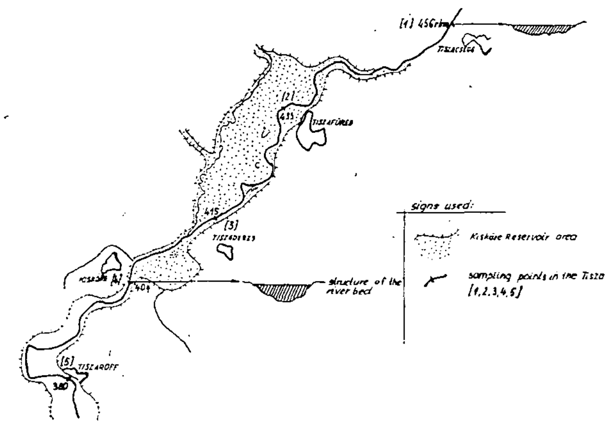

Fig. 1. Sampling points at the Tisza and the Kisköre Reservoir (schemetic plot)

Report on, and evaluation of, the investigations

In case of samples close to the surface the quantity of suspended matter exerted a decisive influence on the transparency of water (VÉGVÁRI 1975).

The transparency values measured in the Tisza from June the 1st 1973 till December the 17th 1974 referred to an exponential connection in the function of the suspended matter (Fig. 2).

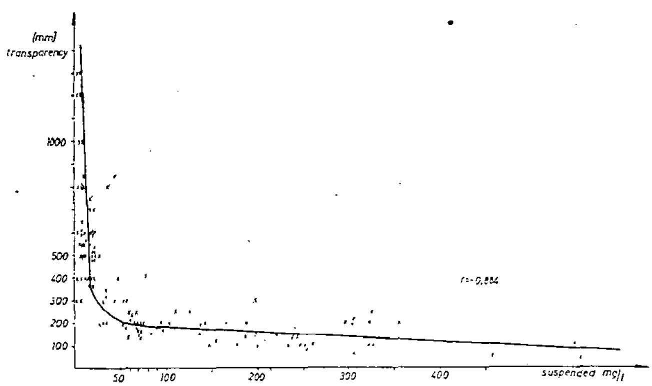

Fig. 2. Hypothetical connection between transparency and the total suspended matter in the current-line samples of the Tisza, from July 1973 till December 1974

The equation is of the type: $y=a.x$ whose constants were reckoned, after being linearized, with the least square method. Taking into consideration 91 cases, the equation is:

$$y = 2090.x^{0\ 51}$$

— the closeness of the stochastic connection for the linearized form is: $r = -0.884$

$$r = \frac{\sum dx \cdot dy}{n \cdot \delta x \cdot \delta y}$$

The connection mentioned may be interesting because a connection of similar character can be demonstrated between the total algal number and suspended matter (Ádámosi *et al.* 1974). If the water is not toxic and its temperature is between (+)10—(+) 30 °C then, from the value of transparency, the other two characteristics, the order of magnitude of suspended matter and total algal number can be determined. We have referred that, of course, only to the Tisza reaches investigated by us, taking into consideration, as well, that in our case the factor inhibiting the multiplication of algae was mostly not the shortness of food.

In case of the natural and artificial lakes, the unfavourable (limiting) effect of a strong eutrophication on water utilization has urged all over the world more and more elaborated investigations, researches. The first period is characterized by the problem of "looking for a clue to the situation". And the new direction is marked recently by comprehensive function-connections. (Rich *et al.* 1972).

A considerable part is attributed to the effects of sediment, the load of the river, resp. suspended matter (Hembree *et al.* 1971), not only as to potential food depositories but also as to adsorbents, resp. absorbents of various matters that make a physico-chemical solubility system connected uniformly with the water masses above them.

The formation of the iron content of water and suspended matter may be interesting the theme (Lee 1971, Golachowska 1971). According to our experiences, the total iron content was higher at flood and lower at small water. After comparing the maximum values to the change in the total suspended matter we could establish that a considerable part of iron content is bound to the suspended matter, increasing or decreasing in close connection with that (Fig. 3).

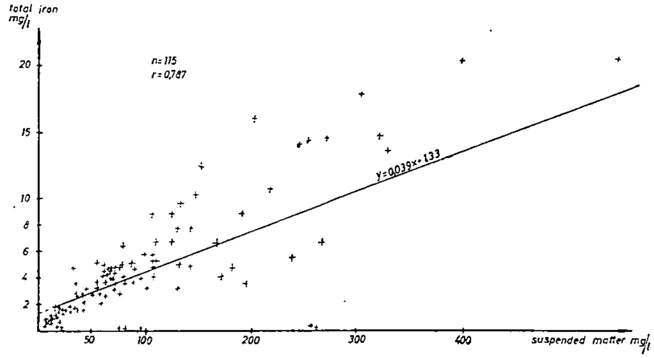

Fig. 3. Connection between the total iron and the total suspended matter content at the sampling points (1, 2, 3, 4) of the Tisza, in 1974

A further remark is that hardly 10 per cent of the total iron content is present in the water in dissolved form. The changes in concentration of the dissolved iron are determined physico-chemically. The change in the total iron content is an order of magnitude higher, even in absolute value.

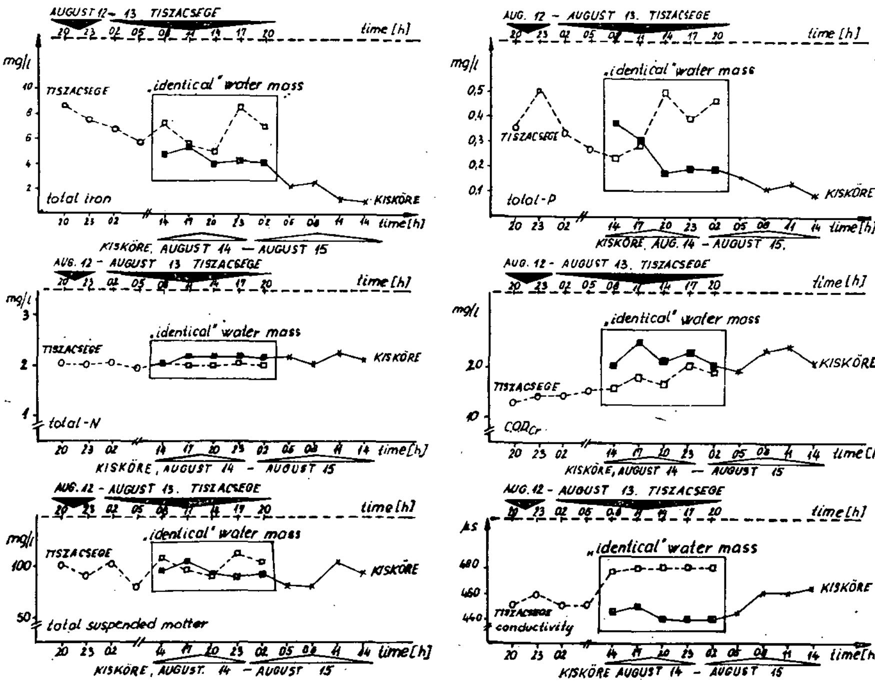

Fig. 4. Some components of the current-line samples of the Tisza at Tiszacsege and Kisköre

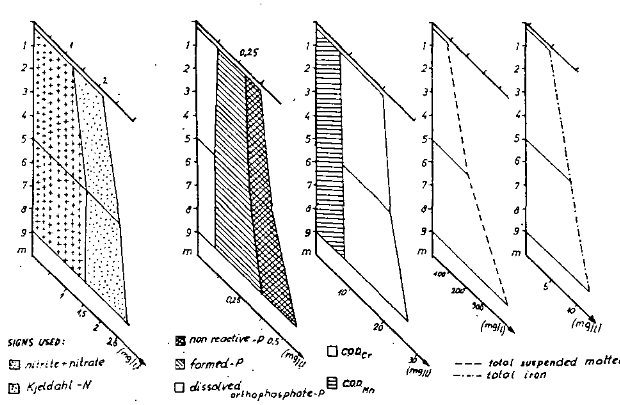

Fig. 5. Some components of the current-line vertical samples at Kisköre, at 14°°, August the 14th 1974

Are we supposing the connection between the total suspended matter and total iron content to be linear, then the equation, calculated with the same method as the former one was, is

$$y = 0.033x + 1.33$$

the value of "r" is 0.787; the number of points is 115.

In case of storage, most part of the iron coming with water settles together with the suspended matter and is accumulating in the sediment of the future reservoir. Here is to be mentioned the part of the sediment of high iron content as one of the factors of fish destruction induced by hydrogen sulphide (VÁMOS 1971), as well as the trophity-decreasing part of the well-settling complex and non-complex iron phosphates in the process of eutrophication.

The time passing between the single samplings was in the former cases one week, resp. a fortnight. River-water being in question, that time was far too much long, the intermediate changes cannot be taken into consideration. Shortening the time, and with regard to the water output, the number and site of samples, as well, we have reached the problem of optimizing.

On April 23rd and 24th 1974 we collected samples from the current-line of the river at Kisköre, in three-hour intervals.

The water output was 300 cc.m/sec. We sampled in the same place at 560 cc.m/sec water output on August 14th and 15th, as well as at Tiszacseg on August 12th and 13th, in a similar way. The starting date at Tiszacsege was determined on the basis of water speed measured at several points and in different depths, our purpose being to sample from an approximately identical water mass and to record the changes taking place in about 60 km reaches.

In order to form a more complete picture, we collected samples of depth at Kisköre on August 14th.

The results of the investigation are charted diagrammatically (Figs. 4, 5).

After elaborating these mathematically, we have drawn the following conclusions:

— in case of a lower water output (50—300 cc.m./sec), the relative dispersion of the surface samples of the current-line is larger than in case of 500—600 cc.m/sec water output. It appears from the results of vertical samples that the quantity of suspended matter is the largest in a depth of 5 to 9 m. The place of maxima was determined by the prevailing drif conditions (speed, specific surface, etc.).

— at measuring the suspended matter content and the components bound to that anyhow, the slightest error is made if we take samples from the depth indicated, possibly with the maximum suspended matter content, with friquency depending upon the water output. Sampling is to be carried out in case of a small water output more often, while in case of a large water output more rarely. In case of a small water output the samples characterize a smaller water mass, the system becomes unstable, the change is only followed by increasing the number of samples. In case of larger water outputs (500 to 3000 cc.m/sec) the system may be considered stable.

— Are we treating of bringing the sample number to the possibly highest perfection, then we have to show due regard, apart from the water masses, for the character of the water motion, as well. We must not ignore the influencing part of the river-bed structure, either. (Cf.: Fig. 1). The relative dispersion of the suspended mater content of vertical samples

was namely 16 per cent at Tiszacseg, while at Kisköre it was 72 per cent, at identical water mass.
- the surface samples or those close to the surface are sufficient for determining the concentration of the materials found in dissolved state, because the river can be considered as homogeneous in regard of the dispersion of the dissolved components.

Our present results may give information for placing the automatic measuring stations planned, as well as for the recording frequency of the single components.

References

ÁDÁMOSI, M. *et al.* (1974): Duzzasztás hatása a Tisza vízminőségére a kiskörei vízlépcső térségében (Influence of damming upon the water-quality of the Tisza in the area of the Kisköre River Barrage). — Hidrol. Közl. *12*, 570—576.

GOLACKOWSKA, J. B. (1971): The pathways of phosphorus in lake water. Pol.-Arch. Hydrobiol. *18*, 325—345.

HEMBREE, G. H. *et al.* (1971): Influences of sedimentation on water quality: an inventory of research needs. — Proceedings of the American Hydraulics Division 1203—1211.

LEE, G. F. (1971): Role of phosphorus in eutrophization and diffuse source control — Water Chemistry Program, University of Wisconsin.

RICH, L. G. *et al.* (1972): Diurnal pH patterns as predictors. — Water and Sewage Works 125—130.

VÁMOS, R.—TASNÁDI, R. (1971): Miért nincsenek a Duna holtágaiban tömeges halpusztulások? (Why aren't there in the backwaters of the Danube mass destructions of fish?). — Hidrol. Közl. *10*, 450—454.

VÉGVÁRI, P. (1975): Water motion of the River Tisza and its connection with the suspended matter content in 1974. — Tiscia (Szeged) *11*.