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INVESTIGATION INTO THE WATER QUALITY OF THE TISZA FROM CSONGRÁD TILL TISZASZIGET

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Abstract

It is to be established, on the basis of the systematic investigation of the Lower Tisza Region for ten years that the water of the river has been polluted and deteriorated in its quality. At present, we can only see at classifying the quality of the water that for collective water supply and for fish husbandry it is of second class.

It is shown by our investigations that the solute oxygen content decreases, the amount of organic matter increases in these reaches. From time to time, the oxygen quantity consumed for oxidizing the organic and inorganic compounds is raised by passing down of sewage-waters. The salt content of water increase of sodium content is shown by the results obtained at our sampling site below the inflow of the Maros, at Tiszasziget - the frontier of the country. Nitrates occur in a considerable quantity. The quantity of ammonia is indifferent because the water supply of the population comes in this stretch not from the water of the river. By the richness in nutritive material, in case of slow water flow, an algal-multiplication of large mass is induced as a result of light. The increasing mineral-oil pollution also draws the attention to the protection of the water quality of the river.

Introduction

The river Tisza runs in the deepest part of the Great Hungarian Plain. It collects the most part of waters from the eastern part of the Carpathian basin, its largest tributaries being partly the Szamos, Körös and Maros, partly the Bodrog, the Sajó — increased by the Hernád — and the Zagyva. — The ground of its watershed area, the composition of its base rock and the decaying processes all have a determinative effect upon the composition of the water of the Tisza (LÁSZLÓ 1974). In Fig. 1, the Tisza stretch investigated by us is illustrated, indicating the sampling sites.

It is to be seen that, in these reaches, the waters of the Körös and Maros may extert an effect upon the composition resp. quality of the water. In this part, the water pollution of different origins does not induce any lasting state, resp. definite change in the composition and quality of water.

In 1968–1978, i. e. during a ten years long span of time, we investigated into this river stretch and could, therefore, follow with attention the changes in the composition and quality of water. During this time we could observe that the water of the river becomes more and more polluted. The composition and quality of water are secondarily influenced by this pollution. The pollution is connected with urbanization, agricultural and industrial activity.

It is, of course, natural that the original water composition of the river, named as primary composition, and also this secondarily developed water composition, are considerably changed by climatic factors, too, namely water output, temperature, and the number of sunny hours, etc. (HORVÁTH 1976).

Survey of methods

In the lower Tisza region (Fig. 1) the composition and quality of water were fortnightly regularly investigated. In the first time, water samples were taken at more sampling points. We were conviced by the analyses that it is enough to take water samples at the five sites marked in the map.

Our sampling sites were the following:

(1) Gauging station at Csongrád	246.0 river-km
(2) Railway-bridge at Szentes (below the mouth of the Körös)	242.0 river-km
(3) Gauging station at Mindszent	216.2 river-km
(4) Pontoon-bridge at Tápé	177.5 river-km
(5) Tiszasziget (frontier of the country)	158.05 river-km

The sampling sites are good characterizers for investigating water composition and quality in these reaches of the river. At these sites, there is no river- or sewageinflow, they are" impulse"-free parts of the river.

For determining water composition and quality, the following methods were used: The quantity of soluble oxygen was determined by manganese hydroxide. The essence of the iodimetric determination of the water-solute oxygen is that in an alkaline solution the manganese (II)-hydroxide oxidizes, under the influence of the solute oxygen, to manganese (III)-hydroxide and this releases, after acidification, from KI pure iodine, equivalent to oxygen, which can then titrated with thiosulphate. The biological oxygen requirement – BOR – was then established on the basis of the decrease of the oxygen content of the original or diluted water sample within a given time. Sodium was examined at 589 nm with flame photometer. The quantity of ammonia was measured at 400 nm on the basis of the reaction of ammoniamercury (II) – iodid complex. This forms with Nessler's reagent, in an alkali medium, a yellowish-brown compound. The colour intensity is proportionate to the quantity of ammonia. Nitrite was also determined on the basis of colour intensity by connecting diazonium with alpha-naphthyl-amine and the reddish violet colour can be measured by a photometer at 520 nm. There was evoked a reaction between nitrate and sodium salicylate in a sulphate medium and the obtained yellow colour was measured at 410 nm with a photometer. The oil content was examined gravimetrically, resp. spectrometrically (ERDEI 1970).

Exposition and discussion of our results

The utilization of the Tisza water is considerably influenced by the deterioration of water. The protection of the water quality of the river in the home stretch and in its whole downflow is fundamentally important. This is, of course, accompained by the requirement of protecting the river-waters getting into the Tisza. Both the organic and the inorganic polluting materials, NH_4^+ and mineral oil, as well, may and do cause many problems because they dissolve difficultly and only in a small degree. These materials prevent the river-water from being used as drinking-water.

The present-day situation of the river reaches investigated is changed by operation the river barrage at Ó-becse. The biological and sedimentary state of this river stretch is changed by the operation of the river barrage.

Nowadays, an essential condition of the management of water supplies is to evaluate and classify water quality. Waters are classified according to their utilization, on the basis of general and special characteristics. Waters are utilized in the following three large groups:

(1) communal, (2) industrial and (3) agricultural water supply. To these three kinds of water utilization, waters are evaluated as belonging into the first and second

classes (I, II). The waters belonging to the first class (I) are clear waters. These waters are suitable to be used for anything, without any particular, special demand. The waters belonging to the second class (II) are a little polluted, are not suitable for cummunal water supply and not always for industrial aims, either.

We have summarized in tabular form the classification of water quality, according to the sampling sites of the river reaches investigated (Table 1).

Table 1. *Classification of the water of the sampling sites*

Utilization:	Water-gauge at Csongrád	Railway-bridge at Szentes	W.-gauge at Mindszent	Ponton-bridge at Tápé	Frontier of the country at Tiszasziget
Communal water-supply	II	II	II	II	II
Industrial water-supply	I	I	I	I	I
Agricultural water-supply					
Irrigation	I	I	I	I	I
Fish-breeding	II	II	II	II	II

The Table is showing the summarizing result of our investigations that, namely, the water of the lower Tisza reaches in uniform from the point of view of its usefulness.

Further on, results obtained are made known in details.

In the Figure transformation of, resp. change in the solute oxygen amount is to be seen the values of the 5-day oxygen requirement shown as a function of time. The plants and animals living in the water — the living world of water — generally breathe from the solute oxygen. The living world of the dry-land can utilize the oxygen of the atmosphere in unlimited quantities — those living in water are, however, in a more special situation. The oxygen content of water becomes partly enriched from the air but partly the oxygen produced in the photosynthetic process of the aquatic vegetation also gets here. Additionally, the quantity of the solute oxygen is diminished by the oxydative process of the organic matters in water. It is shown by the results of our 10-year investigations that the solute oxygen content of the Tisza water is decreasing. The solute oxygen content of the river-water is also influenced by temperature. In Summer, we obtained very low values, measuring 3.5 mg/l and for the winter period even 13 mg/l solute oxygen quantity.

In Fig. 2, the formation of the biological oxygen requirement is also shown. The biological oxygen requirement shows the quantity of the oxygen required for decomposing the organic compounds and the temporal tempo of oxygen consumption, as well. This is named the 5-day biological oxygen requirement. In England, the sewage-waters get to the sea from any place in five days — that is the reason of the designation.

The process of self-purification is aided by microorganisms, as well. For the biological oxygen requirement the quantity of oxygen is calculated as (BOR) mg/1, needed at a duration and temperature for decomposing the organic matters. It is shown by the Figure that the BOR-quantity of the Tisza water increases, its organic-matter loading shows, therefore, an upward tendency.

In Fig. 3, the oxygen quantity consumed at the oxidation of the organic and inorganic compounds in water is shown. The 30–40 mg/1 oxygen consumption value recently occurs more frequently. There are obtained higher values when — periodically — a pollution wave passes down the Tisza and the sampling date coincides with this wave. The average values of our monthly two recordings show equalization in a certain meaning.

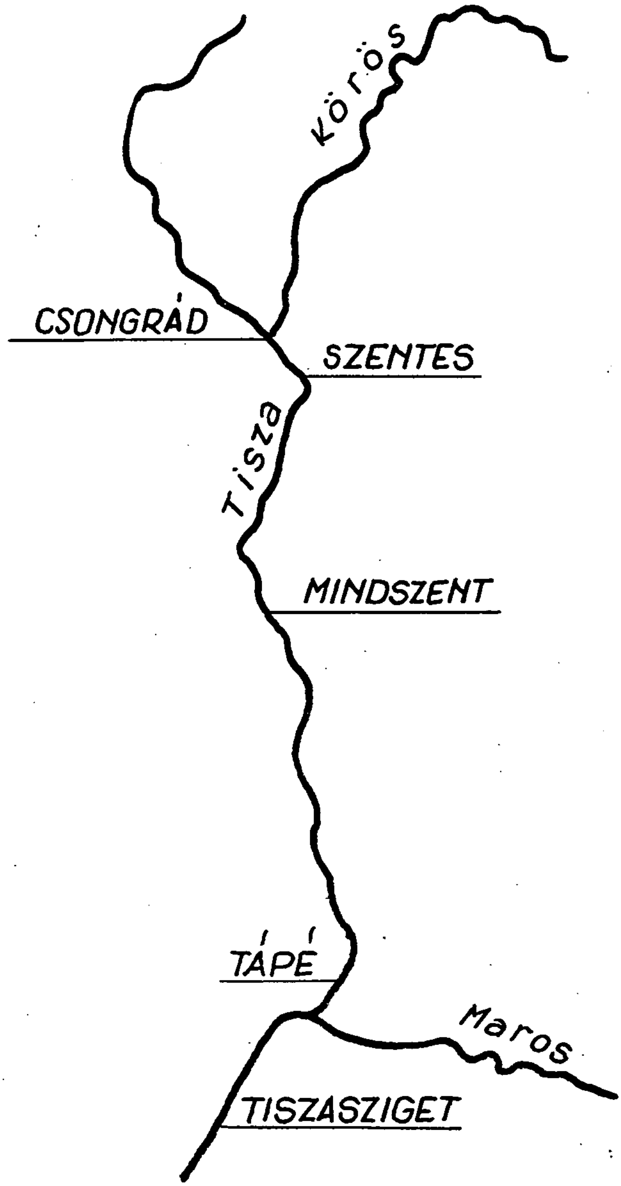

Fig. 1. Sampling sites at the Tisza.

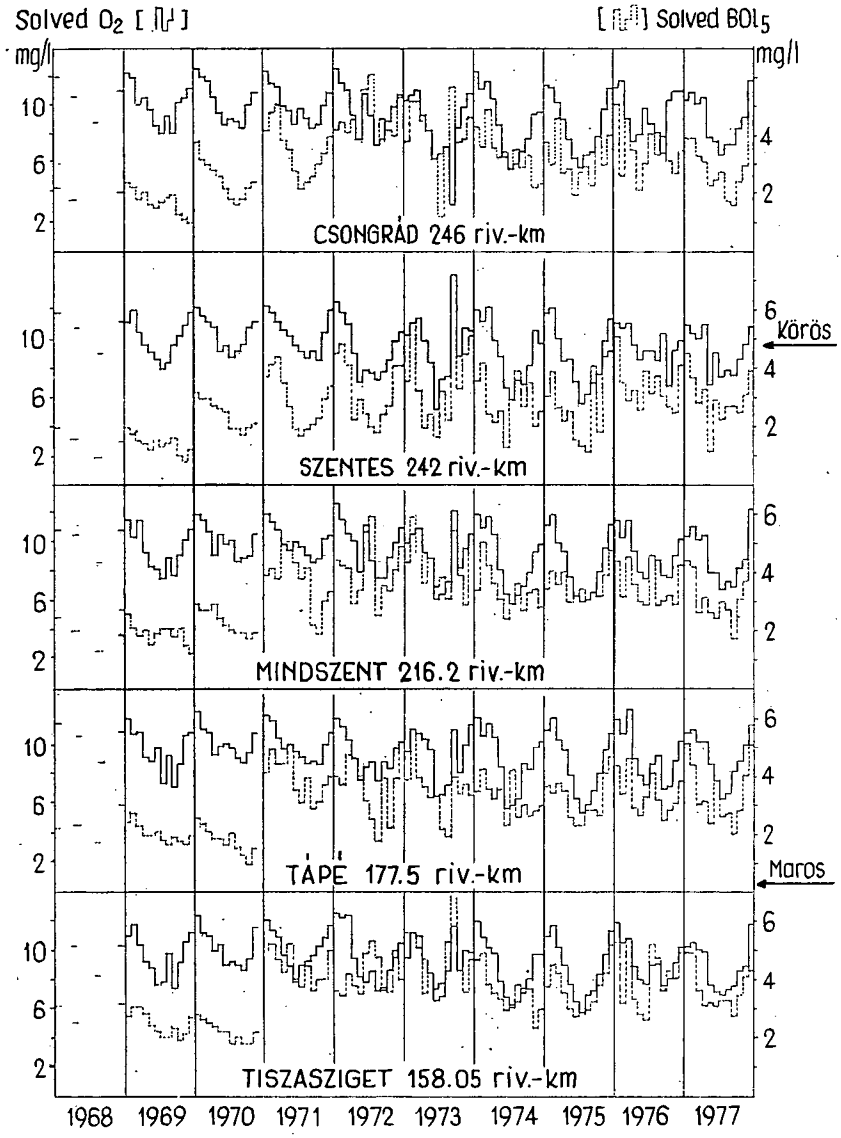

Fig. 2. Formation of solute O_2 and BO/5 in the longitudinal section of the Tisza (1968—1977).
Solute O_2(–) $BO/_5$ (. . .)
mg/1 mg/1
fkm = river-km

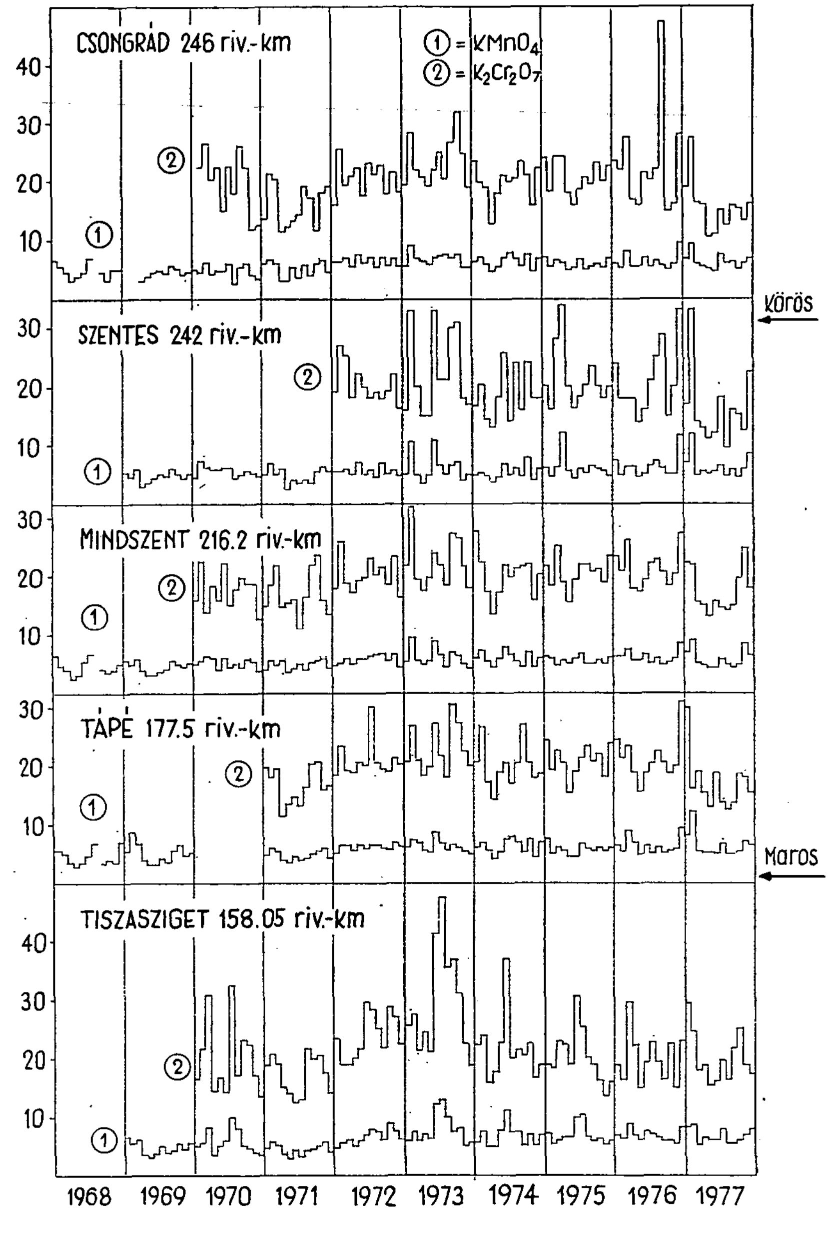

Fig. 3. Formation of the oxygen consumption ($KMnO_4$ and $K_2Cr_2O_7$3 in the longitudinal section of the Tisza (1968–1977).
fkm = river-km

The formation of the solute-matter content of the river water and the percentage of sodium is represented in Figure 4.

Together with the increase in salt content of the river-water, the ratio of alkali decreases. The total solute matter content is determined by the quantity of Ca, Mg, Na, K, CO_3, HCO_3, SO_4, and Cl. The solute salt content is 150–400 mg/l. This is amount and its minor fluctuation (±50 mg/l) is accepted as an average value. The salt content seems to increase a little in the water of the river.

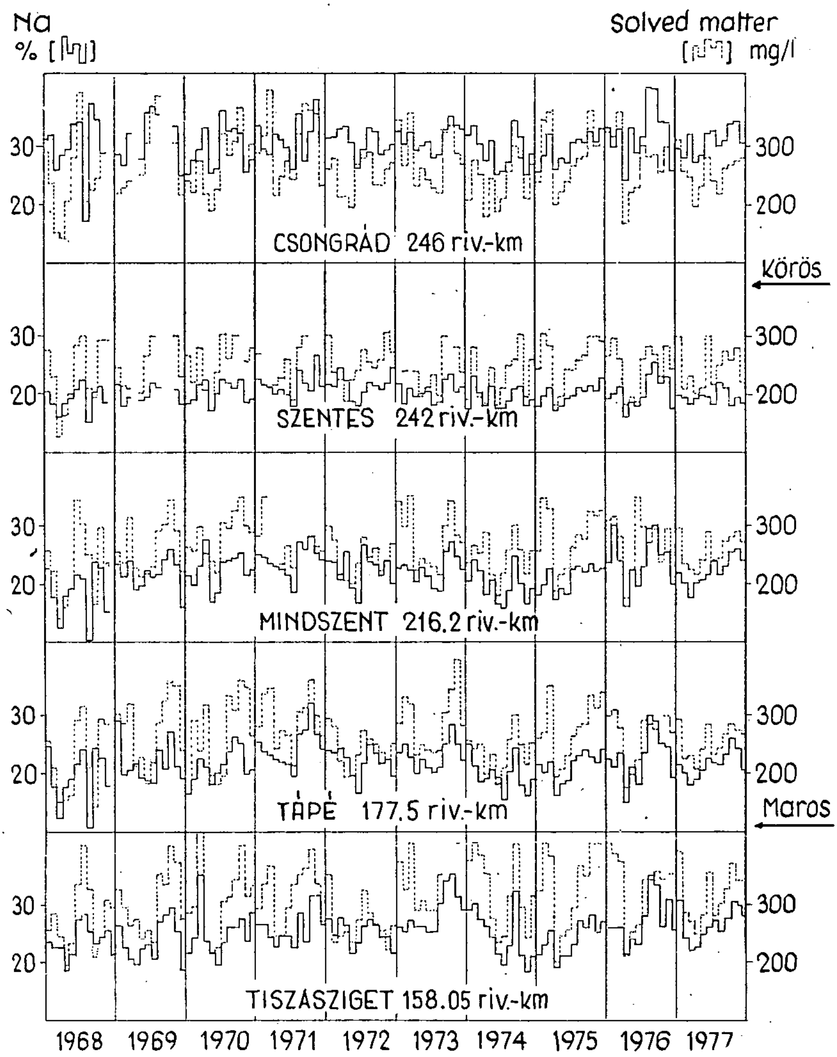

Fig. 4. Formation of the solute matter and Na per cent in the longitudinal section of the Tisza. (1968–1977)
Na p. c. (–) Solute matter (. . .) mg/l
fkm = river-km

At the concentration of sodium ions it was observed that the composition of the Tisza water was influenced by the inflow of the Maros. The sodium content increased both in absolute value and in percentage (Tiszasziget, Frontier of the country). From among the anions chloride ion also occurs. Along the longitudinal section of the Tisza an increase can be observed both in the solute content and in the percentage of sodium.

The change in nitrate and ammonium ions is shown by Fig. 5.

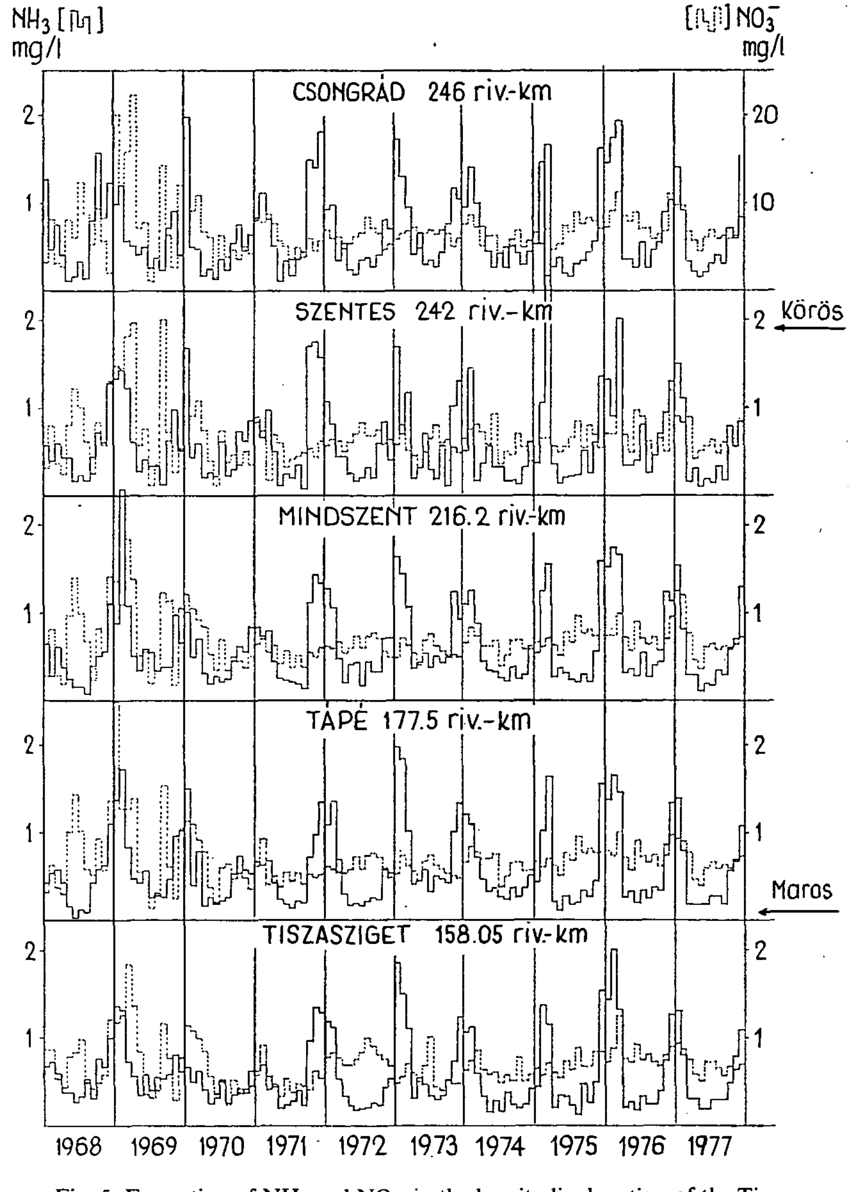

Fig. 5. Formation of NH_3 and NO_3 in the longitudinal section of the Tisza.

The rainwater falling immediately into the river water, averagely contains 0.36 mg/l nitrogen in form of ammonia and nitrate (WURZEL 1975). A considerable part of the nitrogen content of rainwater, and if the precipitation gets immediately into the soil, it is transformed into nitrate by bacteria. Additionally, the subsoil water continues concentrating in nitrate content as the ammonia originating from the plant proteins disintegrating in the soil is transformed into nitrate by bacteria. The subsoil waters give, however, but little nitrogen for the surface. Nitrogen and the phosphoric compounds occur in waters in a very thin concentration. From among the occurences of hydrogen in organic and inorganic compounds nitrates are the most considerable ones. The nitrate content of waters is very low and it changes in annual periodicity, as well. The ammonia content of the water of the Tisza is 1.5–2 mg/l from January till March. This value takes place partly because nitrification is slower at a low temperature, partly because the oxidation of ammonium is pushed into the background by the easily oxidizable organic pollutions of the larger oxygen content. In the stretch investigated — from Csongrád till Tiszasziget — the ammonia quantity is indifferent because the water supply of the population does not originate from the water of the river. It is shown by Figure 5, as well, that the nitrate content in these reaches, increases year by year. The nitrate content is not increased by human settlements or by the sewage-waters of towns but by the large amount of the artificial fertilizers applied in the agricultural and horticultural plant cultivation. The artificial fertilizer gets into the water of the river by running off from land it can at present be said of it that this quantity is not deleterious, as yet. The full operation of the river barragd at Ó-becse may already cause some problems from this point of view. In August 1977, the river barrage still operated only with one sluice. At Szeged, the drift sped of the water of the river was 0.3 m/sec. At such a slow water speed, there can already develop a certain eutrophic state which is rich polluted nutritive matters. The decreased water speed carries but little floating matter. The water-layer is transilluminated by the sunshine well and by the much nutritive matter mass algal multiplication may be brought about.

Of late, from the point of view of water pollution, mineral oil and its derivatives are very considerable. The results of these investigations are to be seen in Fig. 6.

The application of mineral oils and their derivatives has increased very much and these have become permanent polluters of waters. The damaging effect of mineral oils may appear in different ways. Some products have a smell and taste impairing effect even if diluted ten-million times. In a larger amount, they form a membrane on waters and prevent oxygen diffusion and, with that, self-purification. They are harmful in drinking-water even in an amount below the permissible value (threshold value) because they can accumulate in human and animal organisms (toxicity). Of late years, much damage was induced in several places, thus in our country, too, by the pollution of mineral oil and its derivatives. The oil-pipelines, laid down along the rivers, along the Tisza, as well, have already caused considerable pollution. The pollution by water crafts, ships, motor-boats, as well as that originating from motor traffic, public institutions and households are also considerable (Fig. 6). The oil pollution of the Tisza water has yearly intensified by the mineral-oil utilization — water quality is to be protected more and more against this factor, as well.

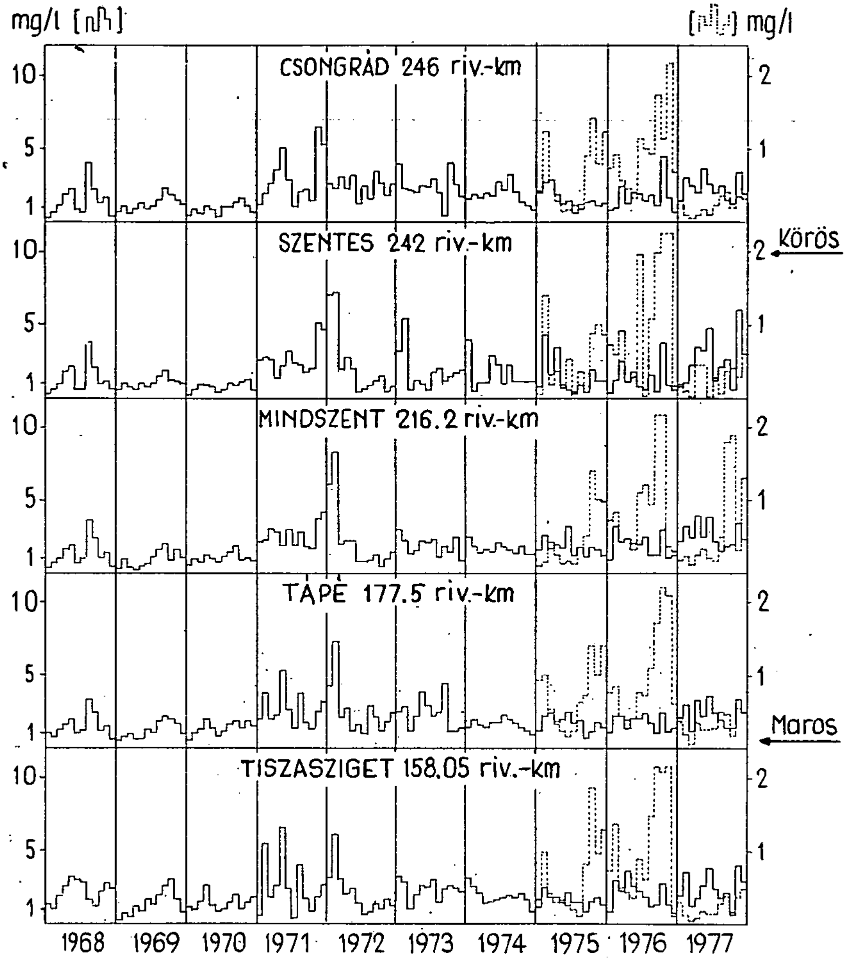

Fig. 6. Formation of the gravimetrically measured and UV oil in the longitudinal section of the Tisza.

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A Tisza vízminőségének vizsgálata Csongrádtól Tiszaszigetig

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Kivonat

Az Alsó-Tisza-szakasz vizének tízéves rendszeres vizsgálata alapján megállapíthattuk, hogy szennyeződik és minőségében romlik a folyó vize. Ma még a víz minőségének az osztályozásánál csak azt látjuk, hogy közületi vízellátásra és halgazdaságnak másodosztályú.

Vizsgálataink mutatják, hogy az oldott oxigén tartalom csökken, a szervesanyag mennyisége gyarapodik ezen a folyószakaszon. Időszakonként a szennyvizek levonulása megemeli a szerves és szervetlen vegyületek oxidációjához elhasználódó oxigén mennyiségét. Növekszik a víz sótartalma, és a Maros beömlése után a Tiszasziget—Országhatár mintavételi helyünkön kapott eredmények a nátrium-tartalom emelkedését mutatják. Jelentős mennyiségbenfordulnak elő a nitrátok. Az ammónia mennyisége azért közömbös, mert a lakosság vízellátást ezen a szakaszon nem a folyó vize szolgáltatja. A tápanyaggazdagság lassú vízáramlásnál fény hatására nagy tömegű alga-szaporulatot okoz. A fokozódó ásványolaj-szennyeződés is a folyó vízminőségének a védelmére irányítja a figyelmet.

Istraživanja kvaliteta vode reke Tise od Csongrád-a do Tiszasziget

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Abstract

Na osnovu 10-to godišnjeg ispitivanja donjeg toka Tise utvrdjeno je pogoršavenje kvalivteta i zagad jivanje reke. Pri kategorisanju, voda po kvaliteta i zagadjivanje II razredna i upotrebljiva je za komunalne potrebe i ribnjake.

Naša ispitivanja pokazuju opadanje količine rastvorenog kiseonika i povećavanje količine organskih materija na ovoj deonici. Pri povremenim zagadjenjima oksidacija organskih i neorganskih jedinjenja povećava i količinu kiseonika. Raste i količina soli, i to natrijuma, iza ušća reke Maros. U znatnim količinama se javljaju i nitrati. Amonijak je prisutan u neutralnim količinama, im, u vidu da stanovništvo ne koristi vodu reke. Bogatsvo hranljivih materija pri usporenom vodotoku pod uticajem svetlosti, rezultuje razmnožavanje velike mase algi. U pogledu zaštite kvaliteta vode pažnju treba obratiti i na tendenciju povećavanje zagadjivanja naftom.

Анализ качества воды р. Тиса от Чонграда до Тисасигета

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На основании систематического, проводимого в течение десяти лет анализа качества воды нижнего течения Тисы можно установить, что вода реки всё более загрязняется и качество воды ухудшается. В настоящее время при оценке качества воды установлено лишь то, что с точки зрения общественного водоснабжения и рыбоводческих хозяйств её следует отнести к водам второго класса. Наши исследования показывают, что в этой части реки в воде наблюдается снижение содержания растворимого кислорода и повышение количества содержащихся в ней органических веществ. Периодический сток грязной воды повышает количество кислорода, потребное для оксидации органических и неорганических соединений. Повышается содержание соли в воде, и анализы, образцов взятых после впадения в Тису р. Марош, в районе Тисасигет-Орсагхатар, показывают повышение содержания натрия. В значительном количестве наблюдаются нитраты. Содержание аммиака в этой части реки не имеет значения, так как снабжение населения водой здесь осуществляется не за счёт речной воды. Высокое содержание питательных веществ при медленном течении воды под влиянием света приводит к массовому размножению водорослей. О необходимости принятия мер по охране качества воды свидетельствует и повышающееся загрязнение минеральными маслами.