

## ORGANIC POLLUTION OF THE MESTA RIVER BED SEDIMENTS

Plamen Ninov, Stefka Blaskova, Julia Kirova, Vessela Rajnova

National Institute of Meteorology and Hydrology – BAS  
66 Tzarigradsko shaussee, Sofia 1784, Bulgaria  
E-mail: Plamen.Ninov@meteo.bg

### ABSTRACT

The goal of the investigation is the qualitative content of the bed sediments along the Mesta river. The special attention is given on the organic compounds in the thin fraction because of higher active surface is the main absorber of organic matter. The problem is directly linked with the ecological and economical assessment of the natural resources.

The results of the investigations carried out show that toll the inflow of the Iztok river there are not registered significant sedimentations of organic matter with anthropogenic origin into the bed sediments. The pollution begins from the mouth of the Iztok river and is spread on a big length diminishing progressively to the Gotze Delchev town.

### INTRODUCTION

The processes of urbanization and industrialization increase significantly the water consumption for irrigation, drinking and industrial purposes. With reference to these processes the quantity of wastewater increases deterioration the river water quality. Depending on the number and the type of pollutants the different river catchment areas are characterized with a different level of pollution.

The prevailing part of the pollutants inflowed into the river water are permanently accumulated in the bed sediments and in appropriate hydrological conditions they could turn into suspended matters becoming a source for a secondary pollution. The problems concerning the bed sediments pollution as well as the mechanism of secondary pollution are not investigated yet. In this sense the carried out expeditions along the Mesta river represent a practical interest from the point of view of the possible economical usage of the bed sediments and assessment of the ecological conditions in the studied river.

### OBJECT OF INVESTIGATION

The catchment area of the Mesta river, with a size of the area 2767 km<sup>2</sup>, includes uniform landscapes - the eastern slopes of the Pirin mountain, southern slopes of the Rila mountain, the western slopes of the Rodopi part Dabash. The mountain character of the catchment area with the average altitude 1318 m defines the formation of a dense river net. Combined with the Mediterranean climatic influence that mountain character impact significantly on the hydrological and sediment regime. The average water discharge near the Bulgarian-Greek boundary reaches 38 m<sup>3</sup>/s that arranges the Mesta river among the typical Bulgarian rivers with mean size.

The main polluters in the studied catchment area are the industrial enterprises in the region of Razlog, Bansko and Goce Deltchev. Partly or entirely these enterprises as the factories for cellulose, condenser paper and yeasts do not work at present. Nevertheless the output pollutants into the rivers for many years partly are still preserved in the bed sediments witch are more conservative medium.

### INFORMATION BASE

The expeditions were carried out at the beginning of the spring flood (the month of March) when the natural biotic component was minimum and in the bed sediments were kept the permanently accumulated pollutants from anthropogenic origin. The sampling was carried out at several monitoring points along the Mesta river from the Iakoruda town till the Bulgarian-Greek boundary. The monitoring points are noticed on the Figure 1. A special attention was paid to the Istok river – the main transporter of the pollutants for years. The sampling was done according the standard procedure adopted in the Laboratory for water quality to the National Institute of Meteorology and Hydrology – BAS.

The cellulose and paper production as well as the yeast production were the main sources of pollution of the bed sediments. The wastewaters from the municipal and agricultural point and no-point sources have smaller impact on the bed sediments pollution. First of all, their quantity is smaller but major reason is the quick degradation of the organic substances. The wastewaters from cellulose and paper productions are characterized with very high level of pollution because of the harmful solutions, colloid solutions and suspensions.

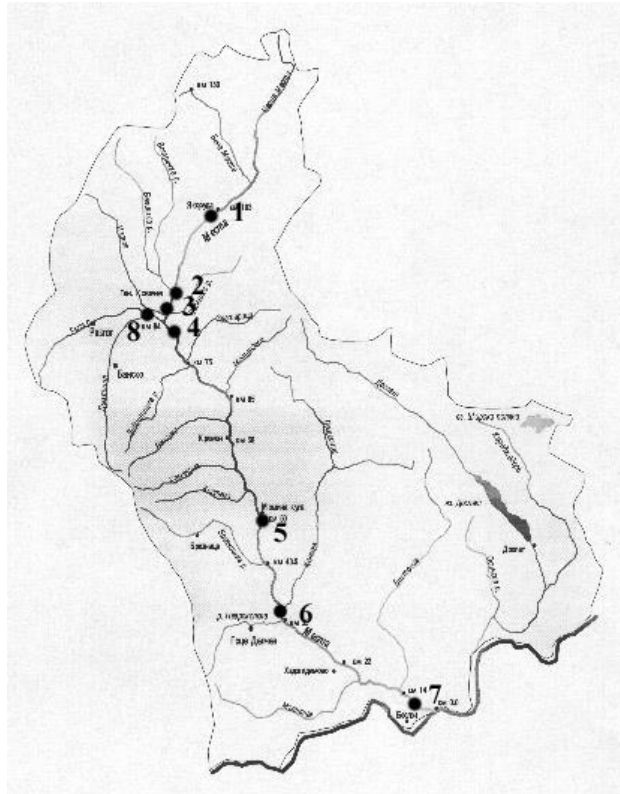


Figure 1. The monitoring points situation along the Mesta river:  
1 - Iakoruda town, 2 - after the inflow of the Belica town,  
3 - before the Iztok river inflow, 4 - after the Iztok river inflow,  
5 - Momina kula site, 6 - after the Goce Deltchev town, 7 - near  
the boundary, 8 - at the Iztok river estuary

The main polluters are the lignins which turn in water-dissolved compounds as a result of alkaline boiling of the cellulose. The lignin gives the wastewater very peculiar brown-red color. The modern methods of water treatment assure a high level of mineralization of a part of dissolved, easy oxidized organic compounds. These methods however do not eliminate the lignin due to their stability. They decompose only 10-15%. Entering the river they are accumulated in the bed sediments jeopardizing the river water with secondary pollution with phenols, hydrogen sulphide, sulphur alcohols etc.

## RESULTS AND DISCUSSION

The results of the carried out investigations show that before the inflow of the Iztok river into the Mesta river there is not any significant accumulations of organic compounds from anthropogenic origin in the bed sediments. The content of anthropogenic organic compounds is registered immediately after the Iztok river mouth and is spread over a long distance, diminishing to the Goce Deltchev town. It is found out accumulated content of lignin, yeasts, and secondary products as a result of their degradation.

The main part of the accumulated in the bed sediments pollutants is absorbed in the fine fractions because of their high specific surface. On the other hand it is interesting to investigate the organic content in the fine fractions because of the possible secondary pollution – the fine fractions are more dynamic. On the Figure 2 can be followed the alteration of the

granulometric content of the suspended matters in 3 points along the Mesta river which reflects the change of the particles size in summarized percentages able permanently to absorb organic matter and to accumulate it on the river bed.

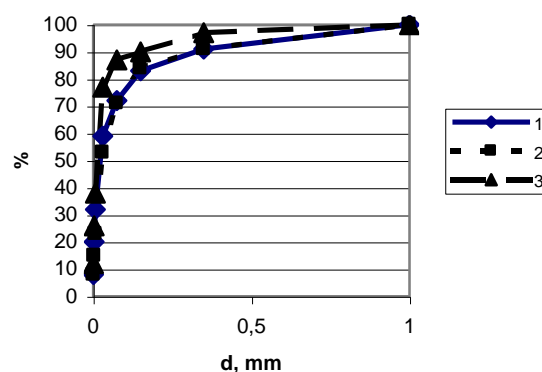


Figure 2. Granulometric distribution of the suspended matters in the Mesta river water for 1 - Iakoruda town, 2 – after Momina kula site, 3- after Goce Deltchev town

That imposes the needs of granulometric analyses and the separation of the fractions between 1 - 5 mm for further chemical and physico-chemical treatment. These particles are undergone of weaker dynamics and at the same time possess higher specific surface area.

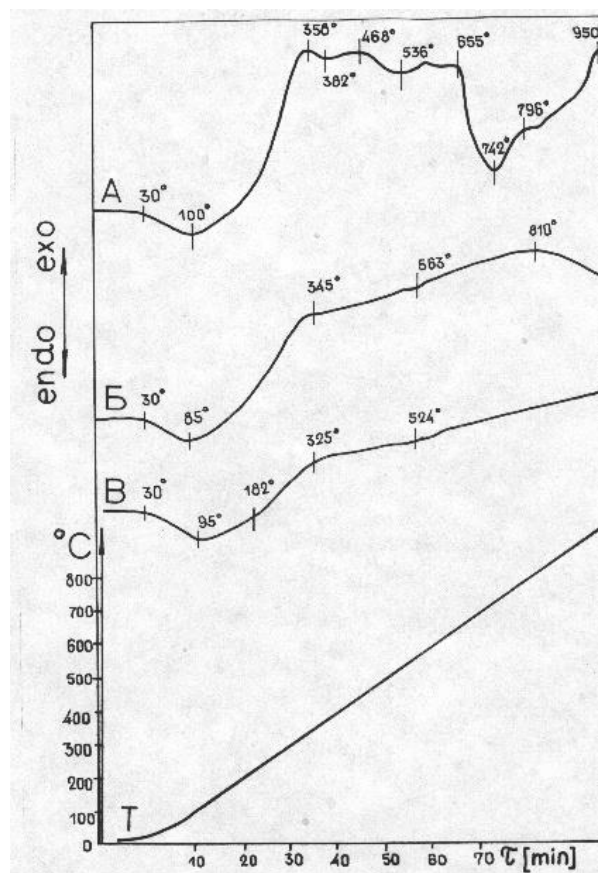


Figure 3. Differential thermal analysis (DTA) of the samples from the stations: A – Iakoruda town, B – after the inflow of the Iztok river, B – Momina kula site

The results of the differential thermal analysis (DTA) are shown on Fig.3. This method registers the thermal effects in the process of heating. The processes of evaporation of the physically and chemically bonded water are completed up to 200°C. These processes are characteristic of the endothermal peak which is typical of the all DTA curves. The oxidation of the lignin is the most intensive on the Fig.2-B, due to their accumulation in the region immediately after the inflow of the Iztok river.

In the sample taken at the Iakuruda town, Figure 2-A, these processes are not observed linked with the full absence of lignin and yeasts. The content of accumulated organic compounds from anthropogenic origins diminish along the Mesta river. The sample taken at the Momina kula site, Figure 2-B, where the graphic is almost uniform, gives ground to the acceptance that their content is insignificant.

On the Fig. 4 are presented the results of the thermogravimetric (TG) analysis, reflecting the kinetics of the thermal decomposition. Comparing the spectra of the samples taken from the Iakuruda town till Goce Deltchev can be seen that the percentage lost of weight diminishes. That is a result of the presence of the big quantity of easy degradable organic compounds which are compounds from natural origin in the most upper part of the studied river stream. The accumulated organic compounds in the bed sediments are a result of the natural process of decay of the vegetation and living organisms which can not be looked at pollutants. As an exception could be examine only the process of human intervention when the biotic medium increases in a large dimension. In the studied case there are not the similar processes.

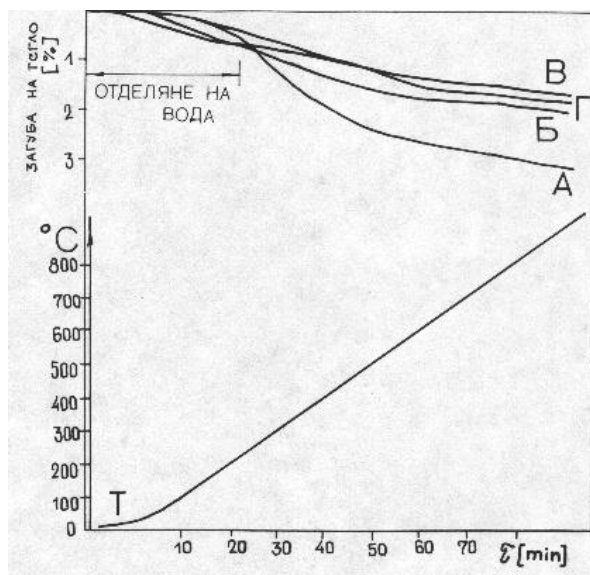


Figure 4. Thermogravimetric (TG) curves for the samples from:  
A – Iakuruda town; B – after the inflow of the Iztok river;  
C – Momina kula site.

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The presence of the mentioned above main pollutants are confirmed by the results of the carried out infra-red (IR) analysis. The registered spectra show the presence of organic compounds. The data of the X-ray fluorescent analysis show the existence of the elements as Al, Ca, K, Fe, Na etc. Consequently the comparison of the results of the both analysis show that above mentioned metals could form metallo-organic compounds of artificial origin (for instance Ca ligninsulphonate) in addition to the basic pollutants. These elements could be also included in the inorganic compounds. This question is not clarified yet therefore additional investigations are necessary. In any case their quantity would be not big.

## CONCLUSIONS

Basing on the carried out investigations could be concluded that the main organic pollutants from anthropogenic origin in the bed sediments of the Mesta river are lignin and the products of their secondary degradation. The highest level of concentration in the bed sediments is registered just after the inflow of the Iztok river. The assessment of the quantity of the organic compounds from anthropogenic origin is very difficult to be done mainly because of their irregular distribution. Furthermore it is supposed that their content is diminishing in the time after the close of the main industrial polluters. Some additional explorations and elaboration of the standard for sediments quality assessments and cauterizations are necessary. Ecological condition of the bed sediments is a constant characteristic of the rivers much more conservative than the river water quality. The investigation of the sediments specification and territorial distribution is directly connected with the economical assessment of the natural resources.

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