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Optical properties of the organic substances from aqueous humus surface waters.

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Translation by A. Murphy.

The dissolved organic matter of surface and ground water is responsible for the characteristic yellow/brown coloration even in the absence of suspended matter. The dissolved organic matter comes from the soil - especially from turf and peaty soils. The water humus of plankton extraction and from turf is of light colour or only weakly coloured (ref. 1)

The colour of dissolved organic matter can be determined by visual methods - filtered waters can be compared on platino cobalt scale and the colour expressed as degrees (ref. 2.) Spectrophotometers were also used.

It was hoped to determine the nature of the colouring agent or organic matter by the establishment of a relationship between the intensity of coloration and the total organic matter content.

44 waters from different sources examined. - their coefficients of absorption of colour and their organic matter content (by dry combustion method Ref. 3.) and permanganate oxidation in acid medium were determined. To remove suspended matter some samples were filtered through a sintered glass filter No. 4 covered with alayer of $BaSO_4$. Spectrophotometric determinations were only carried out on filtered water.

A Pulfrich photometer with 25cm tubes was used. Coeff. of absorption K is given as calculated for 1m. length and also given as a natural log (Ref. 4) Measurements taken in the visible spectrum showed in all cases that the intensity of absorption increased with reduction in the wavelength. i.e. smaller K in the red than in the violet.

K^{436}_F was slightly larger than K^{465}_F and the ratio $K^{436}_F / K^{465}_F \simeq 1.5$ see Fig. 1. - here only K^{465}_F is given.

Fig. 2. - linear relationship between colouration and K^{436}_F with the means of K^{436}_F almost 10x less than the colouration.

There was a lack of correlation for waters of colouration 100, 150 & 260 thus the visual determination is sufficiently accurate as expression of content of humic compounds in the water except at high concentrations.

Colouration of waters filtered by above method is about 80 % of that filtered through paper.

Fig. 3 shows relation between K^{436}_F and oxygen of oxidation (2) and between K^{436}_F and the organic carbon (1) - there is no linear relation between either of these. Similarly in fig. 4 there is no linear relationship between colouration and oxygen of oxidation and organic carbon where filtered waters have been used.

This non linear relationship between the optical density - colouration - and increase in organic matter content points to a difference in the composition and properties of organic matter in these waters.

With increase in organic matter content there is also an increase in quantity of colouring matter.

A partial explination may be shown by comparing the calculated ratios

$$\frac{K^{436}_F}{\text{Organic carbon}} \quad \& \quad \frac{K^{436}_F}{\text{Oxygen of oxidation}}$$

For the 44 samples collected these varied from 0.04 - 0.80

Ratios $\frac{\text{Colouration}}{\text{organic carbon}}$ & $\frac{\text{Colouration}}{\text{Oxygen of oxidation}}$ varied from 1.1. - 8.0. Thus in lightly coloured waters 1 mg C or 1 mg O_2

corresponds to a smaller amount of colouring matter than in deeply coloured waters. The smallest reading of these ratios were obtained in very pale waters which contained very little organic matter.

These waters showed the weak colour of plankton extracted humus and the influence of peaty waters was small.

K^{436}_{F} for sea water - 0.06 (Sea of Azov) 0.19 (Baltic Sea) Ref.5.

O_2 of oxidn.

The higher values of these ratios were found in the very darkly coloured waters of peaty districts which contain much organic matter.

High optical densities for the humic acid from turf have been shown - ref.6. Ratios of 0.20 - 0.45 for K ratios were obtained from over half of the tested waters where there was a water humus of soil extraction. Analagous results were earlier obtained for Col. ratios for waters of the North American lakes (Ref. 7)

Thus it has been shown by these experiments that the determination of the optical density cannot give an accurate guide to the organic matter content, of surface waters.

At the same time optical experiments on natural waters carried out at the same time as the estimation of organic matter (and under conditions which excluded suspended matter, and iron compounds) can be of great help in establishing the nature and extraction of soil humus. Great importance has been arroused in the relationships obtained in studies of the optical properties of the compounds of soil humus and other sources of water humus.

Calculations from Ref. 8. (after transposing into natural logs. the density of a layer 100 cms long at wavelength of 436 mμ) showed that the ratio

$\frac{K_F^{436}}{\text{organic carbon}}$ of the fulvic acid from the alkaline decomposition of podsol turf was 1.3 - for humic acids from various soils 2 -6. The relative contents of fulvic and humic acids in different soils varies (Ref. 9.) and the land extraction of humic acids into natural waters depends on the physico-geographic peculiarities of the drainage area of the river or lake. It would seem that the predominant part of water humus of land extraction (ref.1.) must be made up of fulvic acid, which forms the greater part of the water soluble compounds of land humus.

A comparison of the calculated ratio K to org. carbon for waters humic compounds underlines this suggestion.

Work done on humic compound and surface waters (ref. 10) and work on organic matter reduced by water from the imature soils of the mountain forest belt (ref. 11) and work on the study of the nature of the reduction of organic matter (ref. 12) all show that fulvic acid is a predominant part of the water humus in these studies.

The curves in fig.3 are very close to each other but there is a clear tendency for divergence especially at the limits. -

At small organic content and colouration the ration $\frac{O_2 \text{ of oxidn.}}{\text{Org. C.}}$ is less than 1 - at high organic matter content greater than 1 agreeing with our results.

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