Letter from the CIS

By Alex Yelshin

The problem of sapropel dewatering

It is estimated that the reserves of lake sapropel – which is rich in valuable organic material – in the CIS amounts to billions of cubic metres. This material is now considered to be a valuable natural raw material for use in agriculture, pharmaceuticals and in microbiology. Here we look at aspects of dewatering technology for sapropel extracted in the CIS.

A sharp rise in the prices for energy carriers and raw materials, the restructuring of the economy, and ecological problems in the CIS are increasingly drawing the attention of businessmen and the state to sapropel (organic lake bottoms) as a source of relatively cheap organomineral fertilisers for use in agriculture.

However, it should be noted that although the use of sapropel as a fertiliser is the simplest way to exploit it, it not the most rational way of exploiting its commercial potential as an organic raw material. A number of researchers have reported that sapropel can become a source of valuable raw material for medicines and pharmaceuticals (such as medical muds, biologically active substances, growth stimulators, humin compounds etc.). Sapropel can also be a source of wax and organic substances.

One of the main barriers to commercial extraction and processing of sapropel is the dewatering problem, since more often than not sapropel is extracted in suspension from the lake bottom by suction dredging, with only 2–4% in the solid phase.

Although sapropel extraction has been carried out since the beginning of the century, we cannot consider the industrial technology employed in its dewatering to be anywhere near fully developed. This is because in the former USSR the cost of materials and power resources was kept very low, as well as that of land and water, so there was insufficient stimulus to encourage the development of intensive methods for sapropel dewatering. It is only recently – with the transition of the country's economy to a market-driven one – that the problem of rapid and effective sapropel dewatering has become the key problem in its greater commercial use.

The traditional method

The old, long-winded method for sapropel dewatering was as follows. During the spring, summer and autumn seasons the suspension was pumped into ground storage settlers, where the process of sapropel dewatering proceeded under natural conditions. Sapropel settling and thickening took place in these settlers, as well as dewatering due to water filtering through the draining bottom of the settler, and water evaporation (or freezing out in winter). The dewatering process took from some weeks up to several months, and required large areas for the settlers.

Using industrial technologies

Since the organic component of the sapropel is colloidal, it is impossible to make the transition to industrial dewatering technology without the use of flocculants. Research showed that flocculants must be of the cation type. The amount of flocculant calculated from the dry substance of suspension is in approximately the same range as for active sludge in biological sewage treatment systems.

After treating the sapropel suspension with flocculants, it is possible to employ a variety of dewatering procedures:

- ☐ (1) Pre-thickening in the thin-layer settler → thickening in a sludge settler (thickener).
- ☐ (2) Pre-thickening in the settler up to 8–12% in solid phase → dewatering in the scroll centrifuge.
- ☐ (3) The same as in variant (2), with additional squeezing in a belt filter press or in a scroll filter press.
- ☐ (4) Pre-thickening in a settler → filtration using a belt or drum vacuum filter.

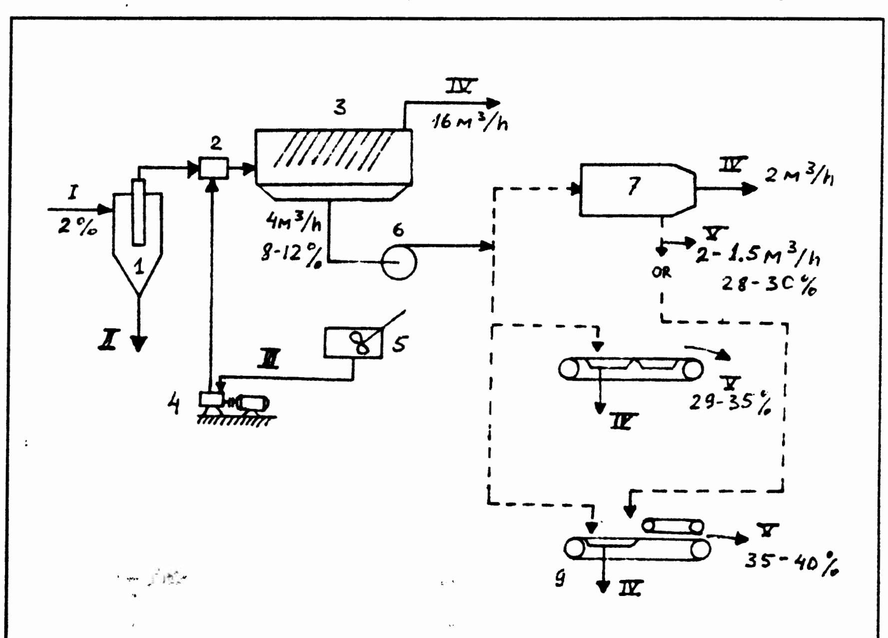
Advantages and disadvantages of these methods

The advantages of these various methods are as follows:

- ☐ Variant 1 is the cheapest, with a minimum of equipment. The number of sludge settlers required is reduced by a factor of 5–8 times.
- ☐ Variant 2 is a continuous process, with a low sensitivity to variations in the thickened suspension concentration at the centrifuge inlet.

Figure 1. Schematic representation of sapropel dewatering and material balance for 20 m^3 per hour of raw suspension (% of solid in suspension). Stage I is the initial suspension, stage II is the sand, stage III is the flocculant solution, stage IV is the water, and stage V is the dewatered sapropel.

(1) Hydrocyclone, (2) mixer, (3) thin-layer settler, (4) dosage pump, (5) tank for flocculant solution, (6) pump, (7) scroll centrifuge, (8) belt vacuum filter, (9) belt filter press.



- ☐ Variant 3 provides the maximum degree of dewatering, making it possible to shape the sapropel (granulation, briquetting etc.).
- ☐ Variant 4 provides sapropel dewatering with a large amount of mineral particles.

The disadvantages of these methods are as follows:

- ☐ Variant 1 results in high humidity of the sapropel.
- ☐ Variant 2 leads to the problem of abrasive wear of the centrifuge.
- ☐ Variant 3 results in high costs when treating sapropels poor in organics.
- ☐ Variant 4 leads to the problem of selection of appropriate filtering materials (filter media).

Practical considerations

A schematic representaion for the dewatering and material balance for 20 m^3 per hour of initial suspension is given in Figure 1.

The dewatering variant was chosen on the basis of the results of a technical and economic analysis.

The problem is more difficult to solve if — at the same time as dewatering of the sapropel — it is enriched with respect to the organic phase (removal of the mineral ingredient, sand).

There are two possible solutions to this problem:

- ☐ (*a*) Enrichment of the initial suspension, before applying the flocculant.
- ☐ (*b*) Enrichment of the dewatered sapropel.

There are some specific features in both cases. In solution (*a*) the removal of the mineral sapropel ingredient — by the use of a hydrocyclone — results in organic losses with the down stream (20–30%); flotation necessitates the use of flotation reagents in order to intensify the process. The possibility of classification in a fluidisation bed for this product has not been investigated.

In solution (*b*), according to different researchers, the optimum sapropel humidity must be less than 40% — *i.e.* additional drying of the dewatered product is required. This is achieved by grinding dry sapropel, and pneumatic classification of the reduced sapropel. However, this raises the potential problem of effective air cleaning.

In all cases it is necessary to keep to the established ecological and sanitary standards with regard to the water returned to the lake, which demands additional equipment.

Conclusions

It should be stressed that it is possible to solve all the problems relating to sapropel dewatering technologies, and under the appropriate market conditions sapropel extraction can be profitable.

However, national sapropel producers (in the framework of the CIS) are faced with a number of complicating factors, such as a limited choice of dewatering equipment manufactured in the CIS, a shortage of cation flocculants, and poor development of deep sapropel processing into valuable products. It is the latter factor that affects the potential profitability of sapropel extraction most of all. FS