ORGANIZATION OF CRUDE OIL PRETREATMENT FOR REFINING

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Considerable attention has been paid recently to the organization of crude oil pretreatment for refining. This has a good reason, since crude oil pretreatment in the oil fields is unsatisfactory and crudes are supplied to the refineries with a high water and salt content. However, in the crude oil pretreatment in the oil field depend the efficiency of the oil refineries, and their capability to meet the increasing demands of the national economy for high-quality petroleum products.

V. I. Luzin's* book published in 1968 is specially concerned with the pretreatment of crude oil for refining. The author discusses two aspects of crude oil pretreatment: 1) dehydration and desalting of crudes in the field, and 2) dehydration of crudes in the field to a residual water content of less than 1% with subsequent desalting in the refinery. He comes to the conclusion that the second alternative is the more economical one. He tries to support this conclusion by the fact that the net cost of the second alternative is somewhat lower than the cost of pretreatment according to the first alternative, for example by 18% in the Central Volga region.

However, only recently the same author in his book "Economics of Crude Oil Pretreatment in the Field and of the Processing of Oil Field Gas" (Nedra, 1964), has reached the, in our opinion, correct but contradictory conclusion that considerable savings of public labor can be achieved in carrying out a complete high-quality pretreatment of the crude (dehydration and desalting) in the field.

We cannot agree with the author's conclusion expressed in his latest book that crude oil treatment in the field can be restricted in all cases to reduction of the water content to 1%, for the following reason: the technological process of crude oil pretreatment and based on it a rational processing scheme depend to a large degree on crude oil quality, and the composition and concentration of salts present in the brines accompanying the crude oil.

The reservoir waters from the oil fields of the Central Volga region have a high mineral content (salt content 280-300 g/liter). After dehydration of crudes from these fields to a residual water content of 1%, up to 1500-2000 mg of salts per liter of water remain in the crudes. By desalting these crudes in the refinery, the salt content can be reduced to 30-60 mg/liter. At present the crudes supplied to the refinery must meet even more severe specifications regarding their salt content (down to 5 mg/liter).

To achieve a reduction of the salt content to this level it is essential to carry out in the field not only the dehydration but also desalting to a salt content of the order of 50 mg/liter. This is confirmed by refinery practice in the member countries of SEV and in the Polotsk refinery, which are all supplied with crude from the "Druzhba" pipeline with a salt content of 50 mg/liter. On the fLOU (electrical desalting) equipment of these refineries the salt content is reduced to 5 mg/liter.

The somewhat higher expenses found by V. I. Luzin for dehydration and desalting of crude in the field are due to the fact that the calculations have been based on obsolete complex crude oil pretreatment plants (CCTP), operating with low efficiency. The possibility of constructing more economical dehydration and desalting plants in the field, using modern horizontal electrodehydrators has not been taken into consideration. The use of dismountable or mobile treatment units in fields with low or decreasing oil production has also not been considered by the author. The application of such units improves significantly the technical and economical factors of crude oil pretreatment in the field to reduce the salt content to 50 mg/liter.

To improve crude oil pretreatment in the field it is essential to supply the oil-producing industry with efficient nonionic de-emulsifiers to replace the obsolete and little-effective NChK. Efficient emulsion breaking can be achieved and its further ageing can be prevented as investigations carried out at UfNI, Giprovostokneft*, and

* V. I. Luzin, Economics of the Pretreatment of Crude Oil and Hydrocarbon Gases in the Petroleum and Gas Industries [in Russian], Nedra (1968).

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TatNII have shown, by introduction of the de-emulsifier into the gas-saturated crude at an earlier stage, thus achieving a better and more prolonged contact of the de-emulsifier with the crude during degassing and transport in the pipes of the crude-collecting system. Therefore it is recommendable to add the de-emulsifier to the water-containing crude not in the pretreatment unit but already on the well head or in the collecting traps. These measures simplify the crude pretreatment in the field and warrant supply of desalted crude to the refineries at lower cost.

When determining the economy of crude oil pretreatment it is necessary to take into account not only the direct costs of crude oil pretreatment, as is done by the author of the book, but also the significant economic effect achieved by the refineries when processing desalted crude.

Processing of desalted crude increases the duration of individual runs in the processing units decreases corrosion, wear, burning of pipes in the furnaces, etc., and allows operation of the plants with maximal productivity, due to reduced contamination of the installations, prolonged catalyst life, and improved quality of the products obtained.

According to the data from Giprovostokneft', the capital expense for the desalting of 100 million tons of crude in the fields amounts to 22 million rubles. According to data from TsNIITneftekhim, the processing of this quantity of desalted crude in the refineries in 1970 can give a saving of about 100 million rubles.

Therefore additional capital investments in the oil producing industry for crude desalting can be recovered in a short time.

The organization of crude pretreatment in the field is also important for the prevention of contamination of sweet water reservoirs with industrial wastes having a high salt content. This problem, of great importance to the national economy, has not been mentioned in the reviewed book.

In the oil field the salt-containing stratal waters, after separation in the crude oil pretreating plant, undergo a treatment on relatively simple water purification units and are returned to the oil bearing formation to maintain the reservoir pressure. In cases where, for some reasons, the return of waste waters to productive layers is not feasible, they are allowed to enter other absorbing formations. Thus the utilization of waste waters in the oil field prevents contamination of natural water reservoirs and secondly saves fresh water for injection into the oil-bearing layer.

In the refineries the problem of waste water disposal is even more difficult. The deposition of waste waters in absorbing formations creates a number of problems. Not in all refinery locations are absorbing formations available for the disposal of waste waters. Even when such a formation is available, water injection is much more expensive than in the oil field. Even in favorable hydrogeological conditions for the subterranean disposal of refinery waste waters considerable capital and time are required to carry out the prospecting. Special wells must be drilled for the disposal of waste waters, the cost of which (with a depth of 1000-1500 m) amounts to 100 to 350 thousand rubles each. The capacity of wells in a non-dissipating formation is not high, about 500 m³/day, therefore a significant number of wells must be drilled and high injection pressures used.

The disposal of refinery waste waters into natural water reservoirs requires the construction of purification plants, including biological purification. Refinery operation requires the purification of large quantities of heavily contaminated waste waters, therefore rather complicated and expensive purification installations are required. The exploitation of such installations also causes high costs.

It must be kept in mind that the existing purification methods are capable of removing only petroleum products and other organic impurities from the waste waters. The salt content of these waters remains practically unchanged. Therefore nowadays the refineries represent sources causing the increase of salt content in natural water reservoirs. A considerable increase in oil refining capacities, assuming that the existing pretreatment of crude oil supplied to the refineries remains the same, will also increase the salt content of the reservoirs each year and may reach threatening levels.

The only way to prevent this increase in salt content of fresh water reservoirs, caused by refinery waste waters, is the desalting of crude in the field and subterranean disposal of the salts recovered from the stratal water.

The dehydration and desalting of crude in the oil field gives not only a better economy of the public effort for the national economy as a whole by reducing costs for crude processing and increasing quality of oil products, but also a better solution for the prevention of salt contamination of fresh water reservoirs and contamination with organic refinery wastes.

This very important factor must be a determining one in any economic analysis of crude pretreatment for processing.