**Why are formaldehyde-based absorbents (scavengers) of hydrogen sulfide and mercaptans not to be used?**

To treat oils for hydrogen sulfide and С1-С2 mercaptans on the fields according to the requirements of GOST Р 51858-2002, technologies using formaldehyde- or triazine-based neutralizers (amine formaldehyde mixtures) are widely used as the most simple and not requiring large investments. Despite efficiency of amine-formaldehyde mixtures as hydrogen sulfide neutralizers they have a number of serious disadvantages, namely:

1. High toxicity due to formaldehyde content, MPC of which (0.5 mg/m3) is 20 times lower than that of hydrogen sulfide (10 mg/m3), i.e. formaldehyde is 20 times more toxic than hydrogen sulfide.
2. Large consumption and high cost. Specific consumption of the neutralizer is 2-3 liters per ton of oil that in monetary terms is 90-120 roubles per ton of oil.
3. Formaldehyde is easily oxidized with oxygen dissolved in oil and gas to formic acid.

H – CHO + 0.5 O2 → HCOOH

Formic acid is a highly corrosive substance, which causes intensive equipment corrosion and reacts actively with ethanol amines on gas-treating units with formation of formates that causes intensive ethanolamine degradation.

1. Neutralization of hydrogen sulfide with formaldehyde follows a reaction:

(n-1)H2C=S

CH2 = O + H2S → H2C = S + Н2О ---------→ [-CH2-S-]n

with formation of hardly dissolved polymer – polymethylene sulfide - which causes clogging of oil pipelines and AVT equipment on refineries (OOO “KINEF”, Saratov and Syzran NPZ and Ryazan NPK). [1, 2]

For hydrogen sulfide and mercaptan neutralization, JS “VNIIUS” developed a reagent (catalytic complex), which does not contain formaldehyde (DMC-1MA process) [3]. The process consists in oxidation of hydrogen sulfide to elemental sulfur and that of mercaptans to disulfides. The oxidation is carried out with air over a catalyst complex – IVKAZ catalyst solution (50 ppm) in NH4OН – at a pressure of 0.4-1.0 МPa and a temperature of 40-50°С. The catalyst complex consumption is 0.2-0.6 kg per ton of oil depending on initial hydrogen sulfide and mercaptan content.

Hydrogen sulfide and mercaptan oxidation follows reactions:

NH4OH + H2S → NH4SH + H2O

Kt

NH4SH + 0.5 O2 → S° + NH4OH

RSH + NH4OH → NH4RS + H2O

Kt

2 NH4RS + 0.5 O2 → RSSR + 2 NH4OH

H2O

DМС-1МА process was implemented for the first time on Кutema UPVSN of Nurlatneft NGDU of PJS “Tatneft” in 2005. The plant provided oil treatment for hydrogen sulfide to its residual content below 15 ppm.

In 2018, on Studentsov field of Samara region on DNS-215 of OOO “TNS-Development” a significant decrease of oil pipeline capacity took place (∅150 mm, L=10 km). Analyses showed that this pipeline, which transported the oil treated with formaldehyde-based neutralizers to the receiver point, was clogged with a mixture of polymethylene sulfide and mechanical impurities.

In 2019, a neutralizer supply unit on DNS-215 was modified for DМС-1МА process, which allowed provide deep (below 15 ppm) oil treatment for hydrogen sulfide.

In 1997, to protect personnel against toxic reagents and refineries equipment against corrosion RD 153-39-026-97 was enacted [4]. In 2000, an order of Mintopenergo [5] was signed and, finally, in 2000, an order of Minenergo was issued [6].

Unfortunately, on May 5, 2011, Minenergo of RF issued order No. 228 [7] about cancellation of all these very important documents, and mass use of toxic formaldehyde-based neutralizers of hydrogen sulfide and mercaptans started. For successful trouble-free operation of oil- and gas-processing plants, certification scheme of chemical products should be restored including compulsory determination of their thermal stability at Т≥350°С and analyses of products of their degradation.

**References**

1. A.R.Vartapetyan, А.А.Zuikov, А.N.Monakhov, I.I.Fyedorov. On a problem of formation of atypical organic sulfur deposits in heat exchanging equipment on primary oil processing plants // Nauchno-tekhnicheskii vestnik of Rosneft OJS. 2016. No. 4. Рp. 82-86.
2. V.А.Tyshenko, I.I.Fyedorov, M.М.Chernova, V.М.Chernova, et.al. Simulation of a process of deposit formation caused by use of formaldehyde-containing absorbents of hydrogen sulfide // Technologies of oil and gas. 2017. No.2. Рp. 14-17.
3. А.F.Vildanov, I.R.Aslyamov, I.K.Khrusheva, et.al. Oxidative-catalytic DМС-1МА process for heavy oil treatment for hydrogen sulfide and mercaptans // Oil industry. 2012. No.11. Рp. 138-140.
4. RD 153-39-026-97 «Requirements for chemical products providing their safe use in oil industry. Requirements for chemical products, rules and procedure for their admission for use in engineering processes of oil production and transportation”.
5. Order of Mintopenergo of Russia No.117 “On certification of chemical products used in engineering processes of oil production and transportation”.
6. Order of Minenergo of RF No. 294 “On prohibition of use of chlor organic reagents in oil production process”.
7. Order of Minenergo of RF No. 228 “Concerning the Annulment of Acts of Mintopenergo of Russia and Minenergo of Russia”.