ENVIRONMENTAL ASPECTS OF THE IN-PLASTIC COMBUSTION METHOD

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ANNOTATION
The article presents the environmental aspects of wet and super-wet in-situ combustion.

Keywords: intensification methods, wet combustion, air factor, ultra-wet combustion, combustion products.

INTRODUCTION

The role of oil and natural gas in the world economy is exclusively great. Oil, gas and products of their processing are used in almost all sectors of the national economy: in transport and medicine, in shipbuilding and agriculture, the textile industry and energy. Oil and gas are mostly cheap energy sources, but with the development of the chemical industry, they are increasingly used as chemical raw materials.

Now a wide variety of products are obtained from oil and gas: synthetic fibers, plastics, organic acids, gasolines, alcohols, synthetic solvents and much more. Oil is a natural mixture of hydrocarbons with an admixture of sulfur, nitrogen and oxygen compounds. It is a natural fossil fuel, but differs from the others in its high hydrogen content and the amount of heat released during combustion. At present, three main areas of oil use have been identified: obtaining energy raw materials, obtaining materials with specified properties, obtaining chemical and pharmaceutical products. Oil created not only a new level of the productive forces of society, but also created a new science of petro chemistry, which arose at the junction of organic chemistry and oil chemistry and physical chemistry. Thus, we see that oil continues to play in the world economy, and therefore in this life of society, a huge role.

All modern methods of enhanced oil recovery imply a deep impact on the reservoir, on the hydrocarbons contained in it. In most cases, even with normal use of these methods, they turn out to be potentially hazardous in terms of environmental pollution. Their harmful effect is possible on all objects: air, water, soil, bowels, flora and fauna, humans.

This means that when using intensification methods, an appropriate complex of environmental protection measures is required.

The essence of the wet combustion method lies in the fact that water injected with air in certain quantities, evaporating at the combustion front, transfers the generated heat to the area ahead of the combustion front, forms in this area extensive, developing heating zones saturated with steam and condensed hot water. The resulting zones of saturated steam are one of the most important conditions of wet combustion, which largely determines the mechanism for displacing oil from productive formations.

The wet combustion method is implemented only in a certain range ratios of the volumes of water and air injected into the reservoir, equal to from 1 to 5 m3 of water per 1000 m3 of air. The air factor of the injected mixture, equal to the ratio of the volume of water to the volume of air, should be of the order of (1-5) * 103 m3 / nm3. At a lower value, the heat transfers to the area of the combustion front decreases, the efficiency of the thermal effect on the formation and the process of oil recovery decrease.

If water is pumped in large quantities, then the wet combustion method turns into other modifications of the combined impact on the formation by combustion and water flooding. The use of the method with a water-air factor exceeding the indicated one does not stop oxidative exothermic processes in the formation even in the absence of a high-temperature combustion zone.

One of the main advantages of the super-wet combustion method is that almost all known processes simultaneously participate and coexist in the reservoir, namely: the displacement of oil by steam, water at different temperatures, mixing the displacement and displacement of oil by gas. Oil recovery is influenced by the products of combustion and low-temperature oxidation of oil in a porous medium, as well as physicochemical transformations of the reservoir rock itself. In the process of combustion, a significant amount of carbon dioxide is formed and oil is displaced by it. In addition, carbon dioxide forms foam together with oil and water, which accelerates displacement. During combustion, surfactants, aldehydes, ketones, alcohols are also formed, which can cause the manifestation of the mechanism of oil displacement by emulsions. It is clear that all these processes and the resulting substances are potentially hazardous to the environment, air, water and soil. It means that the method of super-wet combustion is the most typical among the methods of increasing oil production from the point of view of their danger in terms of environmental pollution.

Considering that the temperature range in the combustion zone varies from 350-1000 °C, one can expect melting, sintering, and a radical change in the composition, structure and properties of the surrounding rocks. Thermogenic subsidence of the surface of the earth, buildings and structures is possible.

Thermal transformations of oil can be accompanied by reactions of isomerization, polymerization, monomolecular decomposition.

Thus, during wet and super-wet in-situ combustion, gaseous paraffinic hydrocarbons, sulfuric anhydride SO3, sulfur dioxide SO2, sulfuric acid aerosol, hydrogen sulfide H2S, hydrogen chloride HCl, carbon monoxide CO, carbon dioxide CO2, phenol C6H5OH, formaldehyde and benz (a) pyrene C20H12.

The components formed during combustion in the formation interact with oil, water, and rocks that make up the formation. In this case, dissolution, chemical transformations and sorption processes are most characteristic. Sorption of the resulting harmful impurities is possible by various rocks, including carbonate and sandstones. Sorption processes can lead to long-term contamination of the subsoil. The formation of sulfur-containing gases is especially dangerous for carbonate rocks. Sulfur and sulfur anhydride reacts with water to form sulfuric acid:

$SO_2 + \frac{1}{2} O_2 + H_2O \rightarrow H_2SO_4$

$SO_3 + H_2O \rightarrow H_2SO_4$

Some destruction of carbonate rocks is possible due to the washing out of calcium sulfate with water.

Despite the absorption of pollutants by collectors, oil, water due to the reversibility of chemical reactions, processes of dissolution and release from solutions, sorption and desorption, harmful substances formed during oil combustion are possible on the surface (Table 1).

Physicochemical methods of enhanced oil recovery (injection of surfactant solutions, PAA, CO2, etc.) for a number of reasons, especially due to the heterogeneity of the reservoirs, did not bring the expected results. In addition, it should be noted that there are significant environmental and economic problems in the application of physicochemical technologies.

Table 1. Maximum permissible concentrations of some harmful substances in the air

Substances in populated Paragraphs maximum one-time	Class dangers	Maximum permissible concentration of MPC, mg / m^3			
		in populated paragraphs maximum one-time	average accurate	in the working zone hedgehog daytime (at 8 hour working day)	aggregate condition
Benz (a) pyrene	1	-	0,000001	0,00015	Spray can
Hydrogen sulfide	2	0,008	0,008	10	Gas
Sulfuric anhydride	2	0,3	0,1	1,0	Gas
Sulfur anhydride	3	0,5	0,05	10	Gas
Carbon monoxide	4	3	1	20	Gas
Phenol	3	0,01	0 01	5	Spray can
Formaldehyde	2	0,035	0,012	0,5	Gas

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