# Study of the asphaltic resinous paraffin sediments (ARPS) dissolution kinetics in hexane compositions

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## ABSTRACT

In this paper the results of the kinetics studies of the paraffin-type ARPS dissolution in hexane, hexane-benzene and hexane-cyclohexane-benzene mixtures at temperature range from 10 to 60$^{o}$C are considered. Half-life periods, the order of reaction, rate constants and activation energies of the ARPS destruction in model systems are determined.

The paper presents the results of the dissolution kinetics study of the ARPS (samples from the Irelyakh gas and oil field (GOF)) in various hydrocarbons at 10 and 25 °C, that corresponds to the seasonal conditions of this field operation, as well as at higher temperatures (40 and 60 °C) to determine the general dependence of the rate dissolution of the ARPS from the temperature. Since the investigated ARPS refers to the type of paraffin [1], hexane was selected as the basic component and its compositions were investigated. We have shown the possibility of the topochemical models application for the description of the kinetics of heavy oil deposits dissolution [2, 3]. Using this method we defined and calculated: limiting stages of dissolution (n), the dissolution rate constants (K), the time when the half of the ARPS will go into solution ($\tau_{1/2}$) and the effective activation energy (Ea) of the ARPS destruction in the studied systems (table 1).

Table 1

Kinetic parameters of the paraffin type ARPS dissolution in various hydrocarbons in the temperature range from 10 to 60 °C

| Models | | n | K, $min^{-1}$ | $\tau_{1/2}$, min | Ea, kJ/mol |
|---|---|---|---|---|---|
| Sample | $t^oC$ | | | | |
| ARPS+Hexane | 10 | 0,84±0,04 | $1,43*10^{-2}$ | - | 51,9 |
| | 25 | 0,97±0,03 | $4,89*10^{-2}$ | 14,17 | |
| | 40 | 1,40±0,03 | $1,81*10^{-1}$ | 3,83 | |
| | 60 | 1,74±0,11 | $2,97*10^{-1}$ | 2,33 | |
| ARPS+Hexane+Benzene (1:1) | 10 | 0,99±0,07 | $3,10*10^{-2}$ | 22,36 | 39,4 |
| | 25 | 1,05±0,13 | $6,10*10^{-2}$ | 11,36 | |
| | 40 | 1,04±0,11 | $1,53*10^{-1}$ | 4,53 | |
| | 60 | 1,13±0,16 | $3,47*10^{-1}$ | 2,00 | |
| ARPS+ Hexane+Cyclohexane+Benzene (1:1:1) | 10 | 1,05±0,03 | $7,28*10^{-2}$ | 9,52 | 35,3 |
| | 25 | 0,94±0,06 | $1,23*10^{-1}$ | 5,64 | |
| | 40 | 1,29±0,11 | $3,58*10^{-1}$ | 1,94 | |
| | 60 | 1,08±0,12 | 1,18 | 0,59 | |

It was established that the destruction process in the binary paraffin - aromatic and triple paraffin-naphthene -aromatic solvents at different temperatures occurs as a first-order reaction (n=1), i.e. the ARPS dissolution rate in these systems neither is limited of the rate of chemical reactions at the interface, nor diffusion. In hexane at 10 °C, this process flows in the diffusion region (n <1), but when heated to 25 $^0$C the process moves from the diffusion regime to the kinetic (n> 1). It was found that the benzene and cyclohexane addition to hexane leads to increasing of the dissolution rate constant, which can be explained by increasing of the dissolving capacity of binary and ternary composites against the ARPS, which is confirmed by decreasing of the effective activation energy of the ARPS destruction. In addition, it was found a positive synergistic effect of the triple solvent action on the ARPS: $\tau_{1/2}$ has higher values, the rate constants higher compared to hexane and binary composite and the process is characterized by a lower value of effective activation energy.

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