

Electrodeposition study on Tahe Atmospheric Residue

Longli Zhang*, Guohua Yang, Guohe Que, Chaohe Yang, Honghong Shan

State Key Laboratory of Heavy Oil Processing, China University of Petroleum, Qingdao, Shandong Province, 257061, P.R.China (* corresponding author: llzhang@upc.edu.cn)

The Tahe Atmospheric Residue (Tahe AR) was diluted by the mixture solvent of toluene and n-heptane, and the electrodeposition behavior was studied under DC electric fields. The DC voltages was 600V, the distance between electrode plate was 0.24cm, and the mean electric field strength was 2.5 kV cm⁻¹. The Tahe AR was diluted by solvent at the ratio of 8 mL solvent per gram sample. Then the mixture was heated to reflux for about 1 hour. Then the mixture was stirred sufficiently by an magnetic force stirrer before the electrode plates were planted into the solution. The stirrer was adjusted to suitable velocity and intensity during electrodeposition experiments. This electrodeposition process would go on for 30minutes under ambient temperature. Then the electric field was shut off and the electrode sediments were cut down and separated into SARA fractions. All of the sediments were fractionated into SARA components, which is showed in table 1.

Table 1. The SARA composition of Tahe AR and the electrode sediments

Diluting solvent Heptan : Toluene	Electrode having sediments	Charge of sediments	Fraction composition (wt.%)				
			C7 - Asp	Resin	Aromatic	Saturate	Asp/ Resin
30:1	cathode	positive	31.7	21.0	27.2	20.1	1.5
	anode	negative	28.0	25.0	27.3	19.6	1.1
20:1	anode	negative	35.8	22.9	24.8	16.4	1.6
15:1	anode	negative	35.8	23.5	25.9	14.8	1.5
10:1	anode	negative	34.1	22.2	26.3	17.4	1.5
8:1	anode	negative	40.1	18.1	23.4	18.4	2.2
heptane	cathode	positive	41.6	19.8	21.6	17.0	2.1
Tahe AR	_____	_____	16.9	17.4	37.6	28.1	1.0

It can be seen from Table 1:

(1) The predominant charge of sediments changed from negative to positive as the n-heptane percentage in mixture increased. When the ratio of mixture solvent was less than 20:1 (n-heptane volume to toluene volume), the precipitation could be found mostly on the anode, showing that the sediments were negative. This result was similar to the zeta potential of Middle East Atmospheric Residue solution[1]. On the contrary, when n-heptane was used as solvent, the sediments were positive. This phenomenon was consistent with the former research that asphaltene was positive[2], and resin was negative. Because when the colloidal core of

asphaltenes was sufficiently peptized by resins, the particle was negative. When the percentage of n-heptane in diluting solvent increased, the peptizing resins would disassemble from colloidal particles, and the particles will be positive[3].

(2) When the ratio of mixture solvent was at 30:1 (n-heptane volume to toluene volume), both positive and negative colloidal particles presented. The weight ratio between asphaltenes and resins was calculated. The value for cathode was larger than that of anode markedly, indicating that the cathode sediments contained more asphaltenes, which was consistent with the electric charge characteristics of asphaltenes and resins.

(3) Both asphaltene and resin contents in sediments were more than that in Tahe AR, indicating that the electriferous particles in residue were mainly consisted of asphaltenes and resins.

The electrodeposition behavior of n-heptane maltene derived from Tahe AR was studied. The diluting solvents used were n-heptane, n-pentane, or the mixture of n-heptane and toluene. The diluting ratio was 8mL solvent to 1.0 gram maltene sample. The measurement equipment and electric field strength were the same to that used for Tahe AR.

Table 2. The electrodeposition behavior of n-heptane maltene derived from Tahe AR

Diluting solvent	Anode	Cathode
n-heptane	a small quantity of sediments	no sediments
n-pentane	a small quantity of sediments	no sediments
Heptane:Toluene equal to 5:1 (V:V)	no sediments	no sediments

It can be seen from Table 2 that there existed electriferous particles in Tahe n-heptane maltene when diluted by n-heptane or n-pentane, and this result was accordant to the negative charge of resins. In addition, the particle quantity was far less than that of Tahe AR, since the sediment amount was less than that of Tahe AR.

References

- [1] Zhang L.L., Yang G.H., Que G.H. (2005) J. of Fuel Chemistry and Technology, 33 (1) : 125 - 128.
- [2] James R.W., Richard R.M. (1963) J. Colloid Sci, 18 (3) 223 - 236.
- [3] Spencer E.T. (1988) Fuel, 77 (8) : 821 - 828