

## Supplementary data

### **In-situ sorbent formation dispersive solid phase extraction for multi-elemental analysis in petroleum: A new approach using cyclen and magnetic ionic liquid**

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### *Preparation of magnetic ionic liquids*

For preparation of [BMIM][FeCl<sub>4</sub>] and [HMIM][FeCl<sub>4</sub>] MILs, 1 mol FeCl<sub>3</sub> and was mixed with [BMIM]Cl and [HMIM]Cl under nitrogen stream and the mixtures were stirred for 12 h. The obtained liquid products were utilized in the extraction procedure. The steps of the MILs preparation were according to a literature [S1].

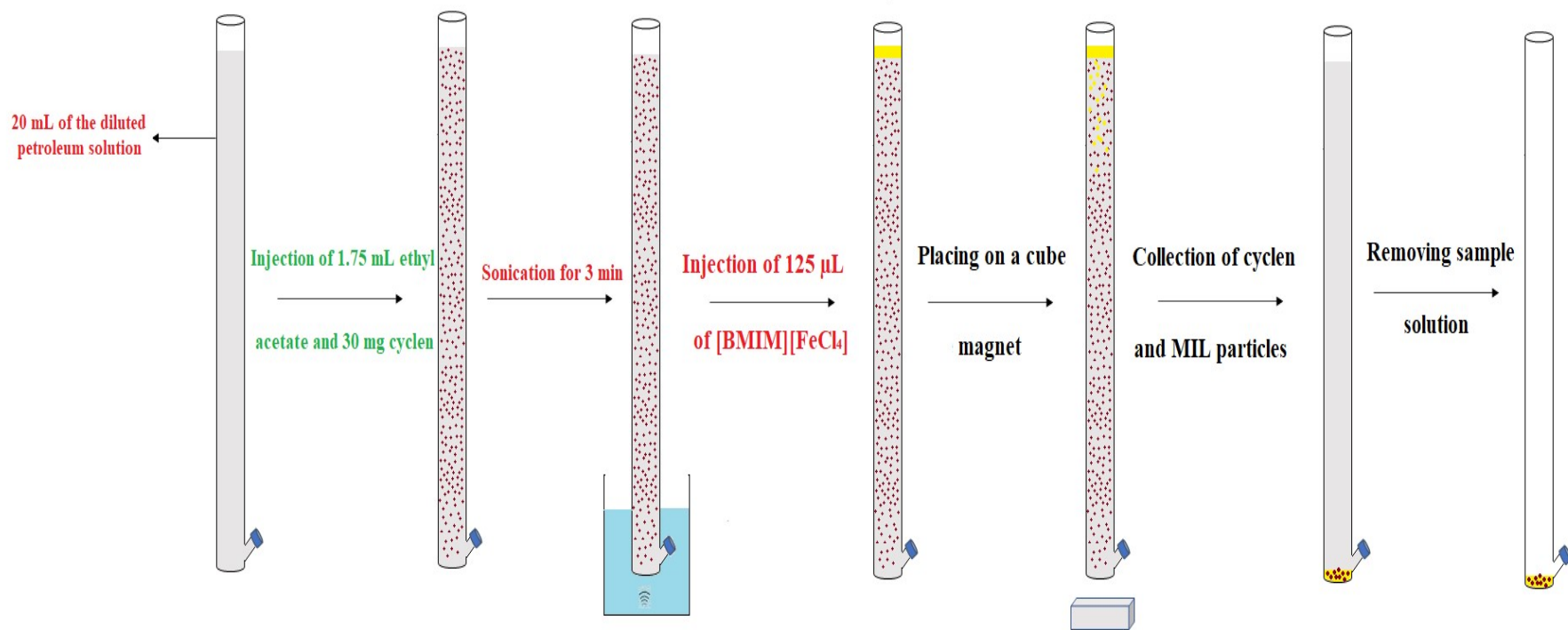


Fig. S1. Extraction method steps.

Table S1. Mean values of obtained the results by the standard method (ASTM D 5708) and the IS-DSPE-ICP-MS method.

Cation	Crude sample #1			Crude sample #2		
	ASTM D 5708 standard method	Introduced method	t statistic <sup>a</sup>	ASTM D 5708 standard method	Introduced method	t statistic
Both samples were analyzed without adding the studied analytes.						
Ni	89.2 ± 0.19	92.4 ± 0.03	1.36	98.6 ± 0.07	103.1 ± 4.3	1.96
V	18.3 ± 0.10	16.5 ± 0.06	1.54	26.4 ± 0.08	24.3 ± 1.2	0.79
All samples were spiked with the cations at a concentration of 10 ng g <sup>-1</sup> . <sup>b)</sup>						
Ni	9.32 ± 0.03	8.96 ± 0.05	1.56	10.61 ± 0.03	11.3 ± 0.07	1.74
V	8.96 ± 0.05	9.63 ± 0.02	1.03	9.85 ± 0.05	10.8 ± 0.13	1.89

a) t-Critical=2.23 for n=4 and p=0.05

b) The analytes contents were subtracted.

Table S2. Analytical eco-scale values for the introduced method [S2].

Parameter	Penalty point	
Energy	≤1.5 kWh per sample	1
Instrumentation	ICP-MS	1
Sample amount	< 10 mL	1
Waste	10-100 mL	2
Cyclohexane	Hazardous	8
Cyclen		Probably 1
MIL		0
Total penalty point		13
AES		87

## References

- [S1] X. Li, Q. Zhou, X. L and S. Zhang, Densities and viscosities of binary mixtures of magnetic ionic liquids 1-alkyl-3-methylimidazolium tetrachloroferrate with ethyl acetate at temperatures (293.15 to 323.15) K. *J. Mol. Liq.* 2019, **243**, 285-292.
- [S2] A. Gałuszka, Z.M. Migaszewski, P. Konieczka and J.Namieśnik, Analytical Eco-Scale for assessing the greenness of analytical procedures, *Trends Anal. Chem.* 2012, **37**, 61-72.