

Properties of new three-component hydrophobic eutectic solvents based on BTMPPA

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INTRODUCTION & AIM

Today, a pressing scientific task is the development of new solvents for extraction processes. One of the promising classes of solvents are hydrophobic eutectic solvents (HES), the main advantages of which are the ease of their production, low fire hazard and the ability to vary their properties by correctly selecting components.

The aim of the present work is to study of properties of new hydrophobic eutectic solvents based on di(2,4,4-trimethylpentyl)phosphinic acid (BTMPPA), trioctylphosphine oxide (TOPO), metyltrioctylammonium chloride (MTOAC) and phenol. DES BTMPPA/phenol (1:3) was previously studied. MTOAC and TOPO were added as a third component to assess their effect on the physico-chemical and extraction properties.

METHOD

DES preparation: stirring, 60 °C, 1h, molar ratio 1:1:2

Chemical interactions between the components of HESs were studied using ¹H, ³¹P NMR and FTIR spectroscopy.

The dependences of physical properties such as density, viscosity, and refractive index of HESs in the range from 15 to 60 °C were studied.

Also, using ¹H NMR spectroscopy, the stability of the proposed HESs when interacting with water and acid, as well as their solubility in water, were studied.

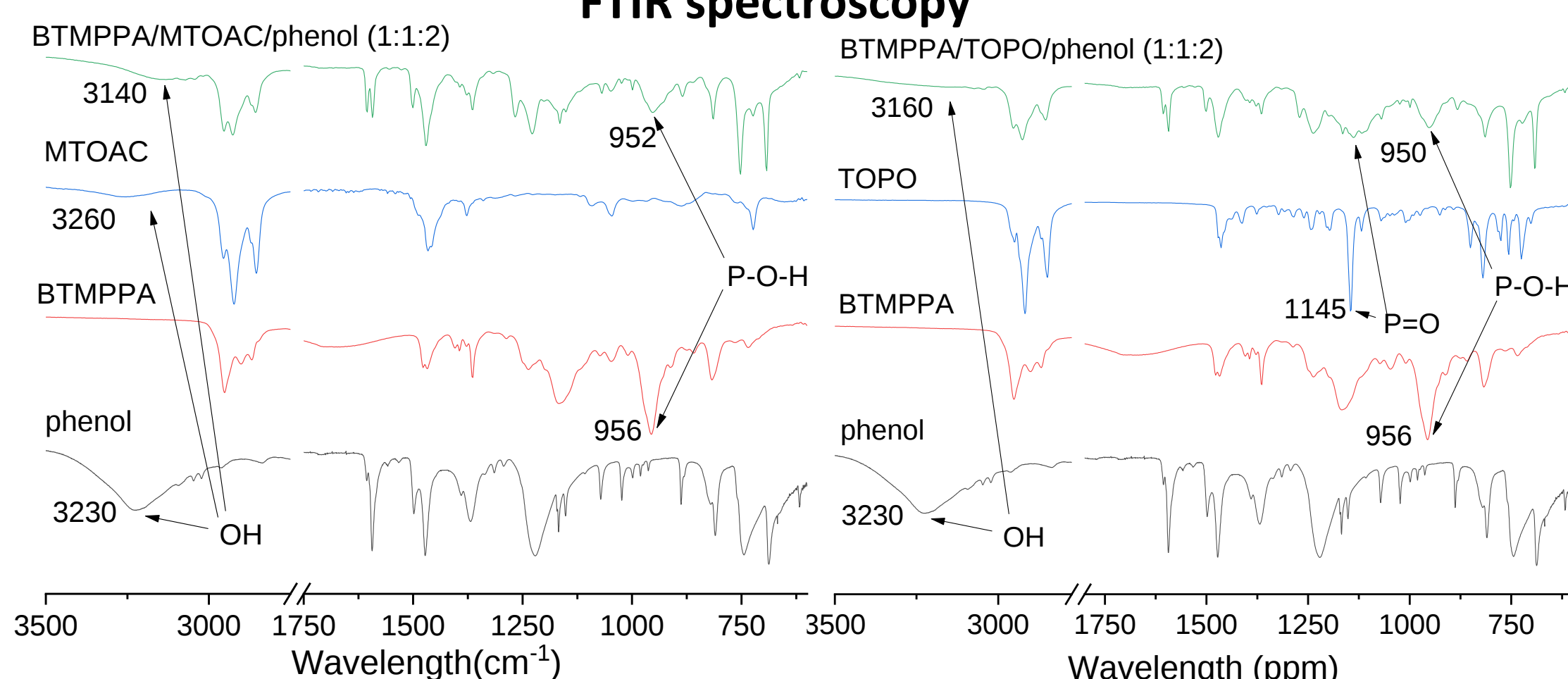
Extraction experiments: V_{org}/V_{aq}=1, [Nd]_{init}=0.01 mol/L

All extraction experiments were carried out at a temperature of 25 °C and an atmospheric pressure of ~100 kPa in graduated centrifuge tubes with a thermostatically controlled shaker.

Determination of Nd(III) concentration in aqueous phases was carried out using titration with xylenol orange.

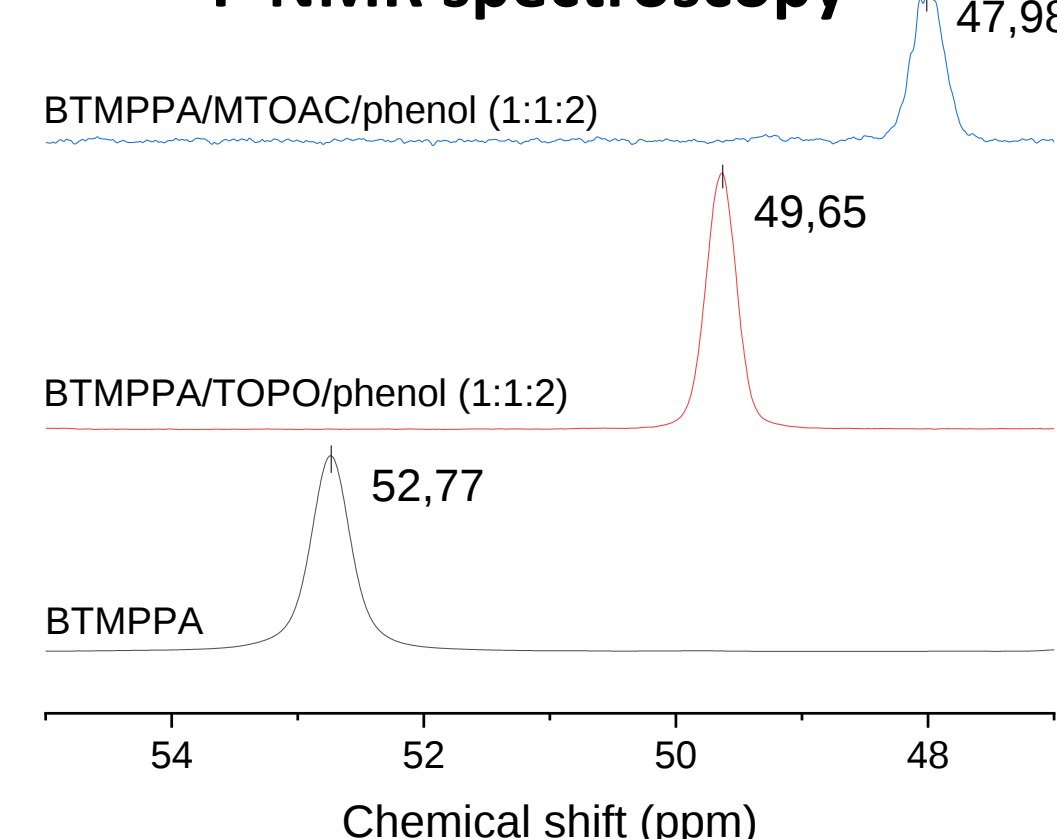
RESULTS & DISCUSSION

FTIR spectroscopy



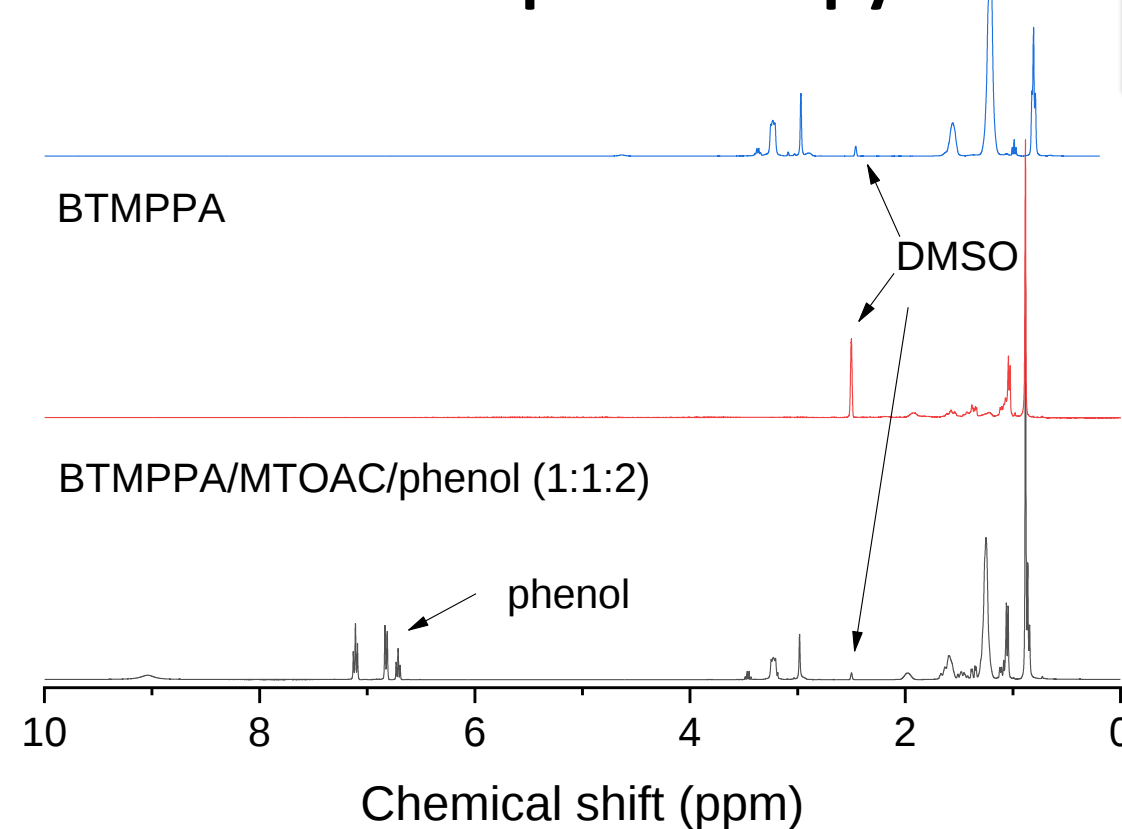
The presence of shifts in the peaks of vibrations of the functional groups of the components of HESs indicates the formation of hydrogen bonds

³¹P NMR spectroscopy



The shift of the phosphorus signal indirectly confirms the presence of a hydrogen bond in the mixture

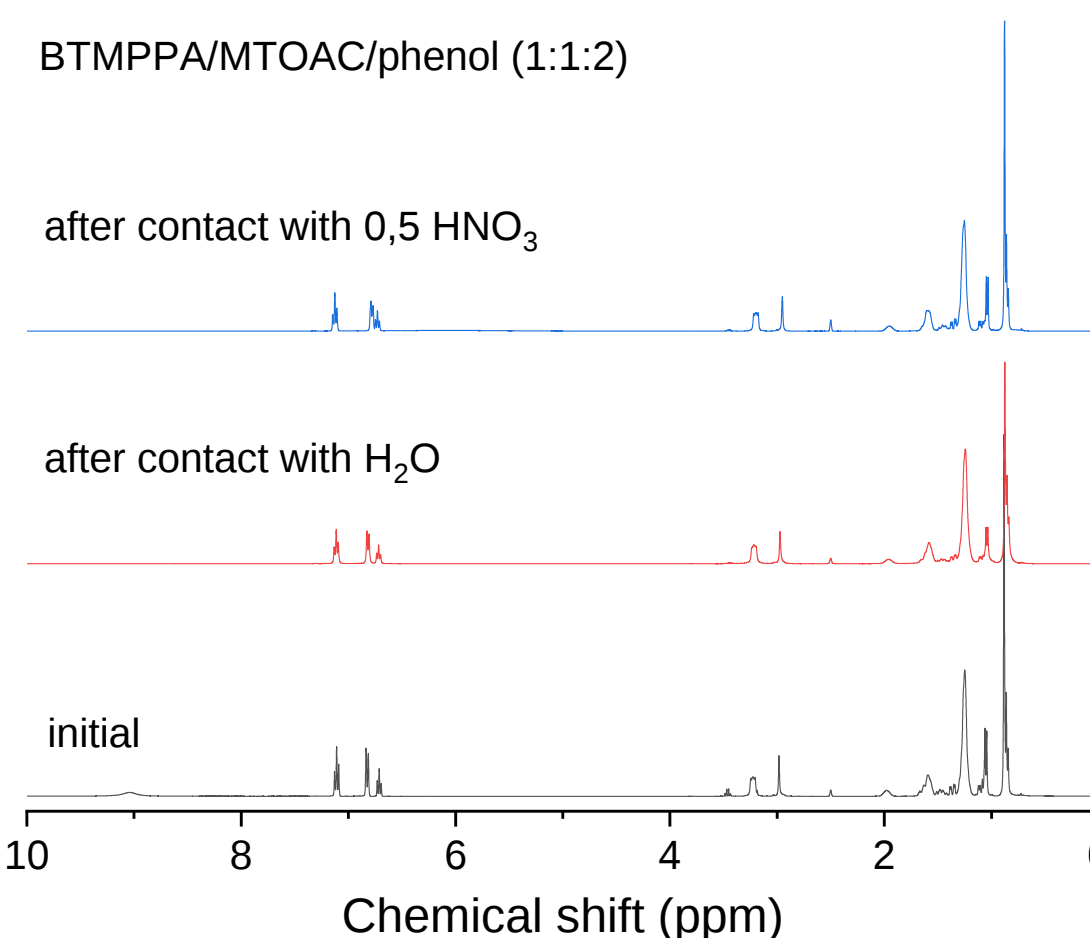
MTOAC ¹H NMR spectroscopy



NMR spectroscopy confirms the molar composition of the mixture and the absence of unwanted interactions

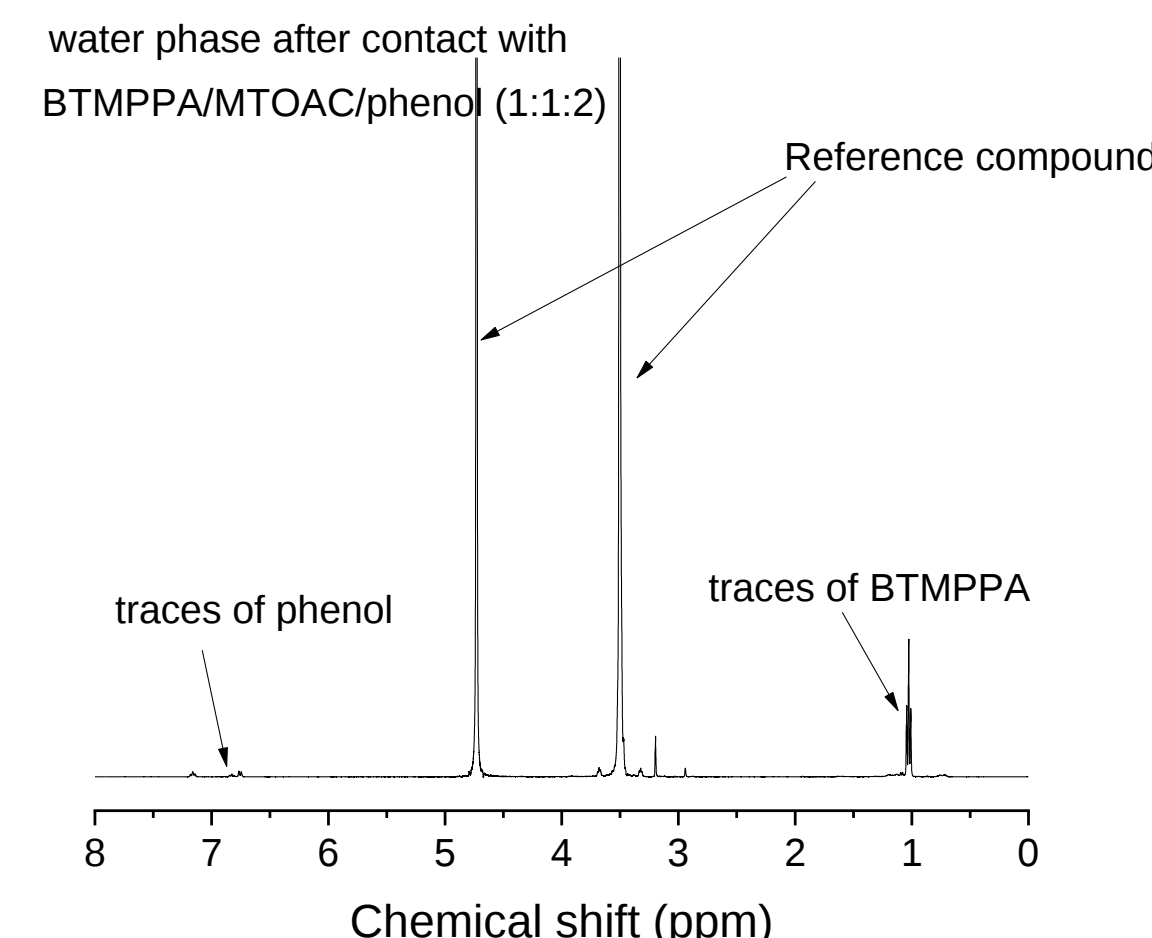
RESULTS & DISCUSSION

Stability of HESs



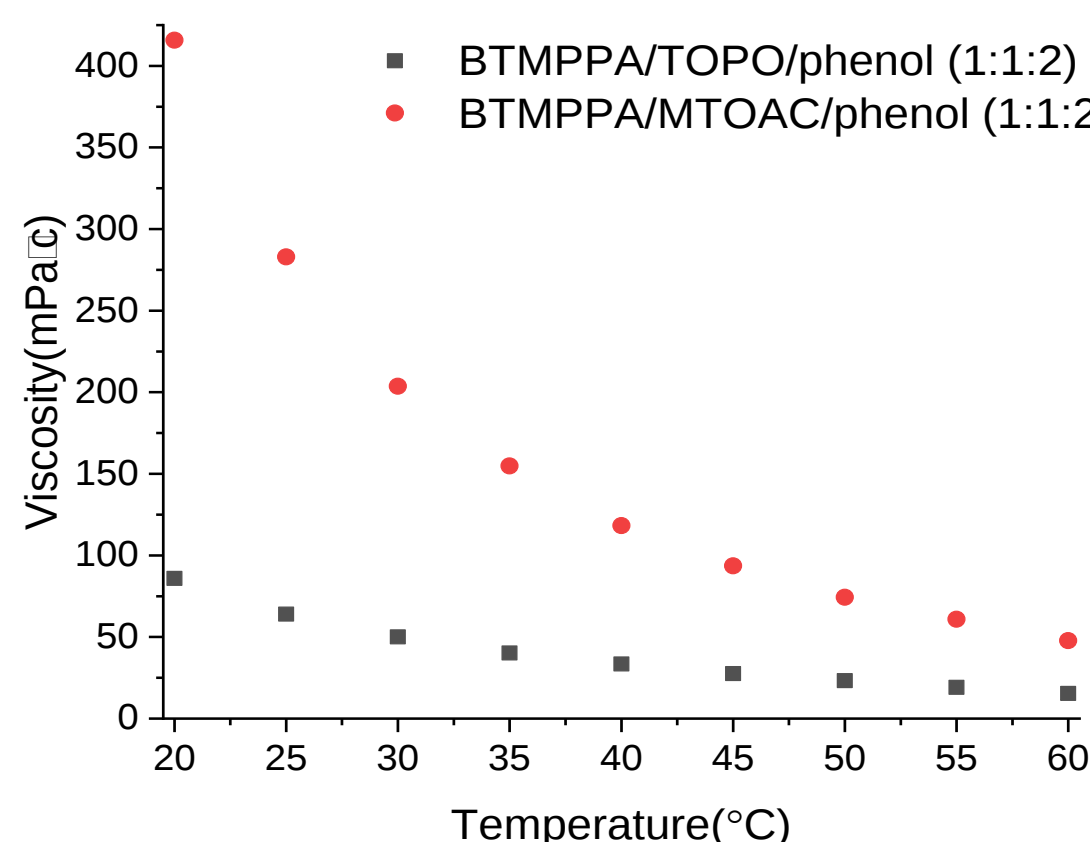
HESs do not degrade when exposed to 0.5 mol/L nitric acid solution and water

Solubility of HESs



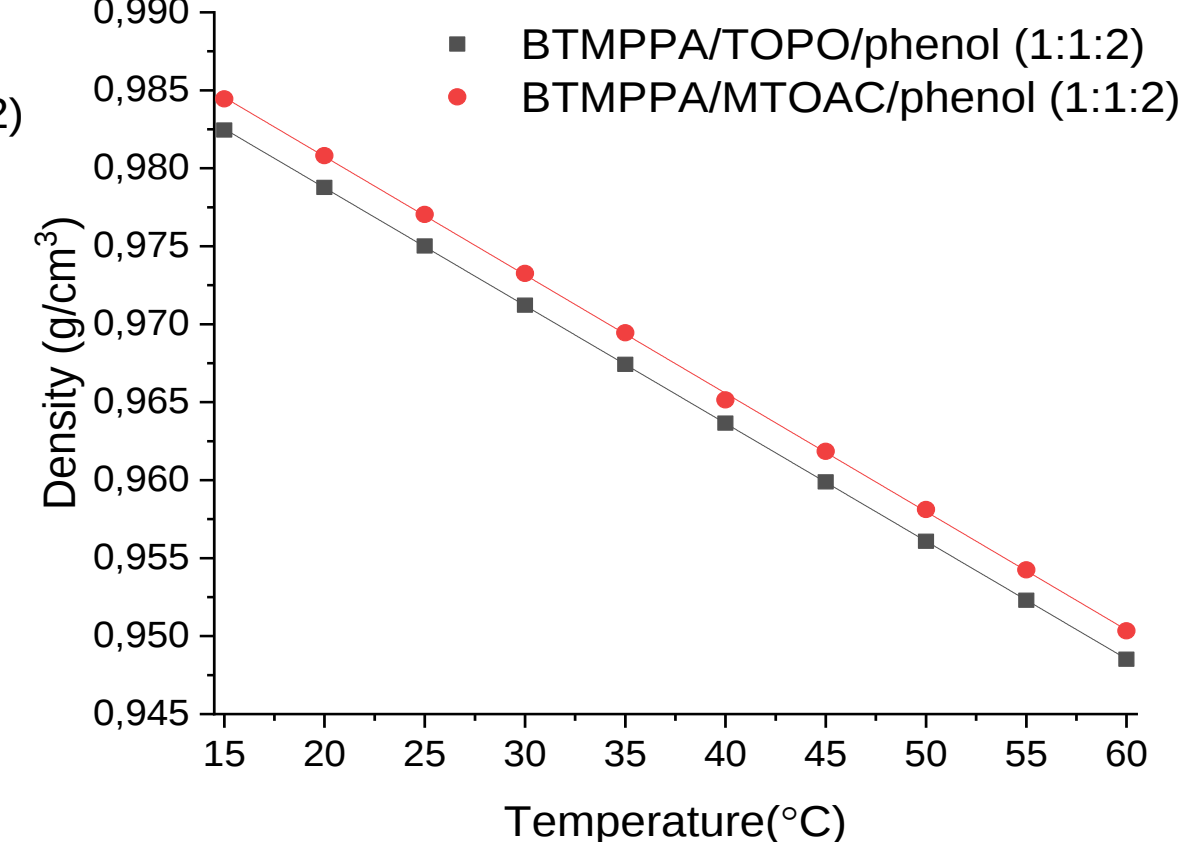
HESs are practically not washed out into the aqueous phase

Viscosity of HESs



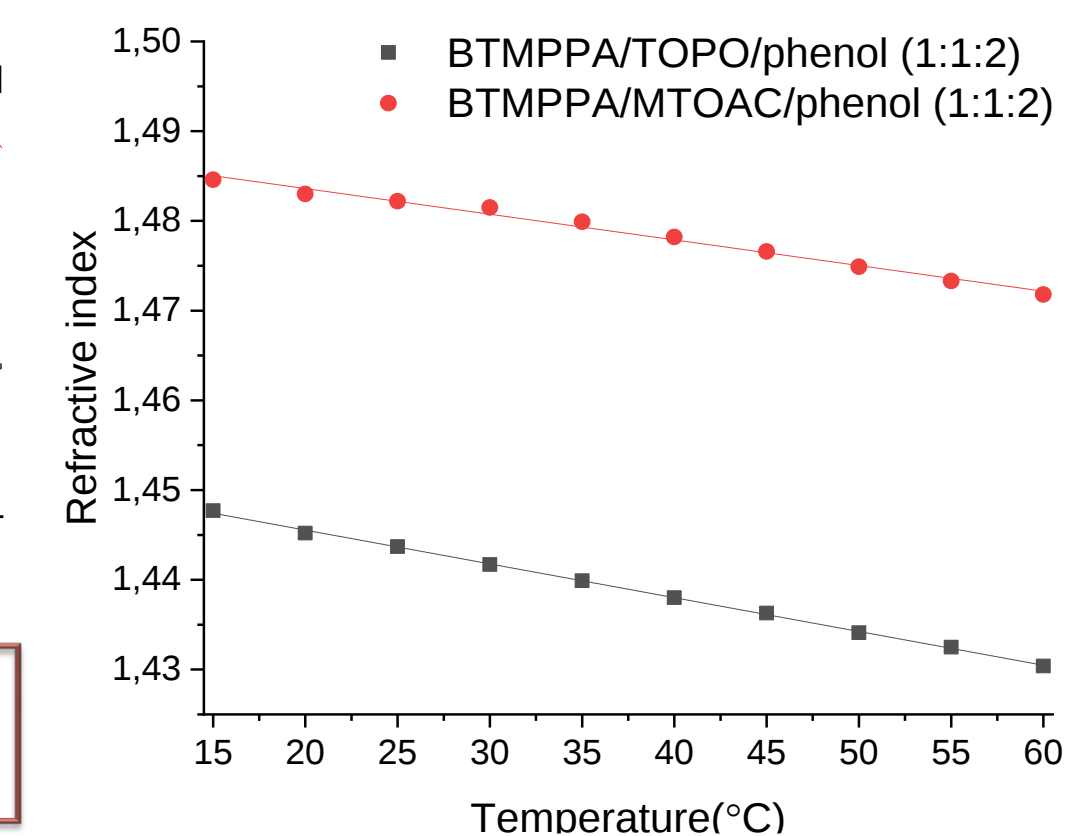
The viscosity of HES BTMPPA/TOPO/phenol reaches 64 mPa·c at 25 °C, which shows its potential applicability in technological processes

Density of HESs



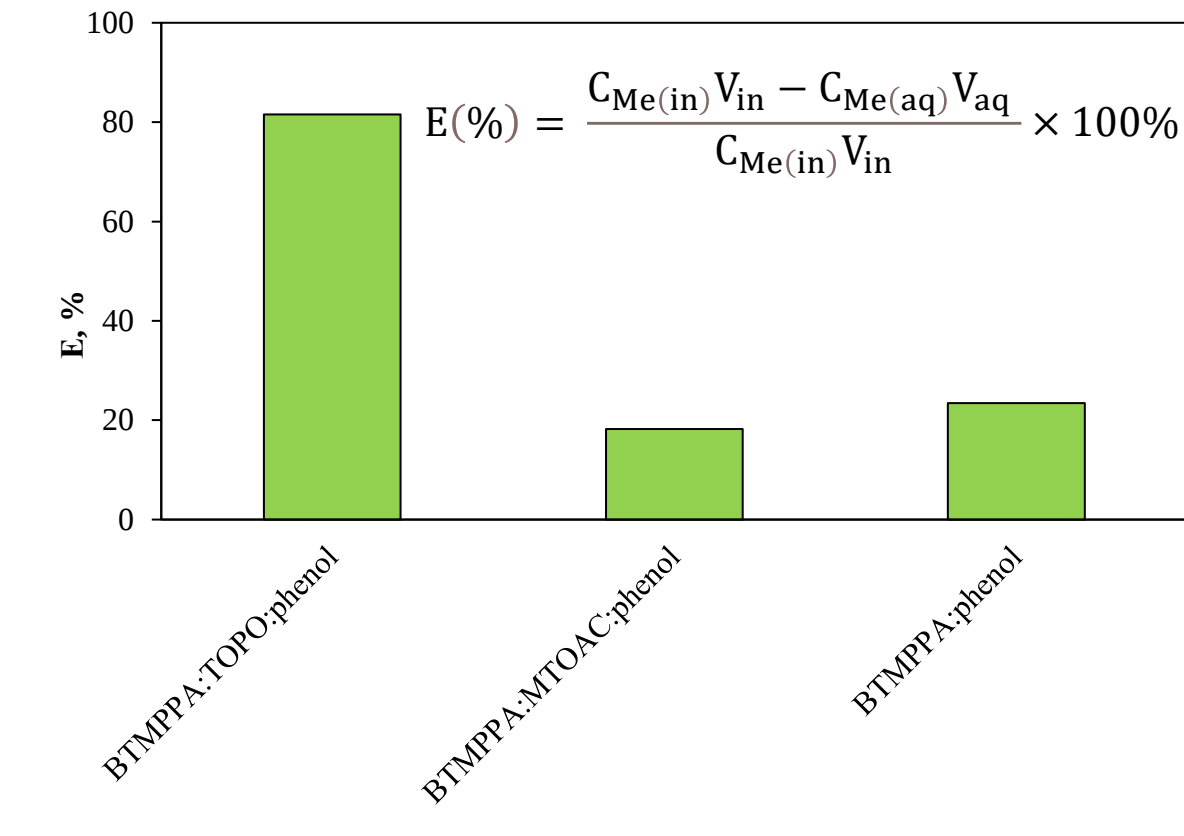
The density values decrease linearly with increasing temperature

Refractive index



The refractive index values decrease linearly with increasing temperature

Extraction of Nd



HESs are promising for REE extraction process

CONCLUSION

The proposed three-component compositions demonstrate the presence of hydrogen bonds and have promising physical properties for use in REE extraction. The obtained data can be used in the development of new effective hydrometallurgical processes of rare earth elements extraction from leaching solution of spent magnetic materials.

FUTURE WORK / REFERENCES

Work on studying the extraction of other REEs will be continued.