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The low-cost hybrid sorbents for immobilization of dyes: sorbents features characterization

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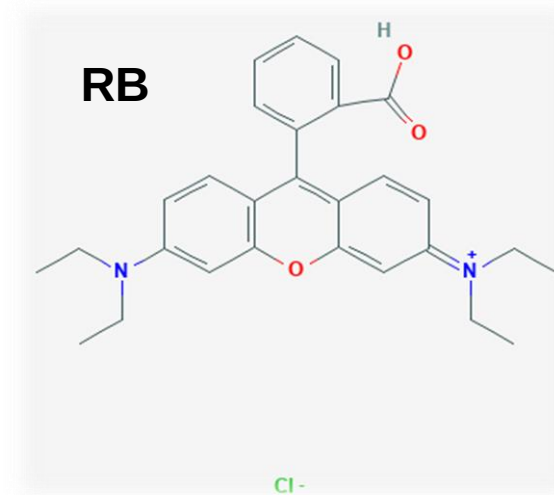
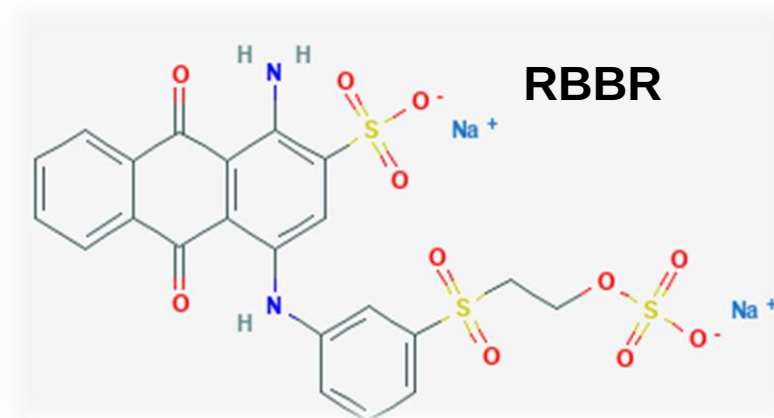
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Introduction

The sorption experiments were conducted using the hybrid sorbents: **halloysite-fly ash (HPL)** and **palygorskite-lignite (PLG)**. Moreover, the **halloysite (H)** and **lignite (LG)** were also investigated to compare sorption properties raw sorbents and hybrid sorbents.

Two dyes were tested in experiments:

- » **remazol brilliant blue r (RBBR)**
- » **rhodamine b (RB)**

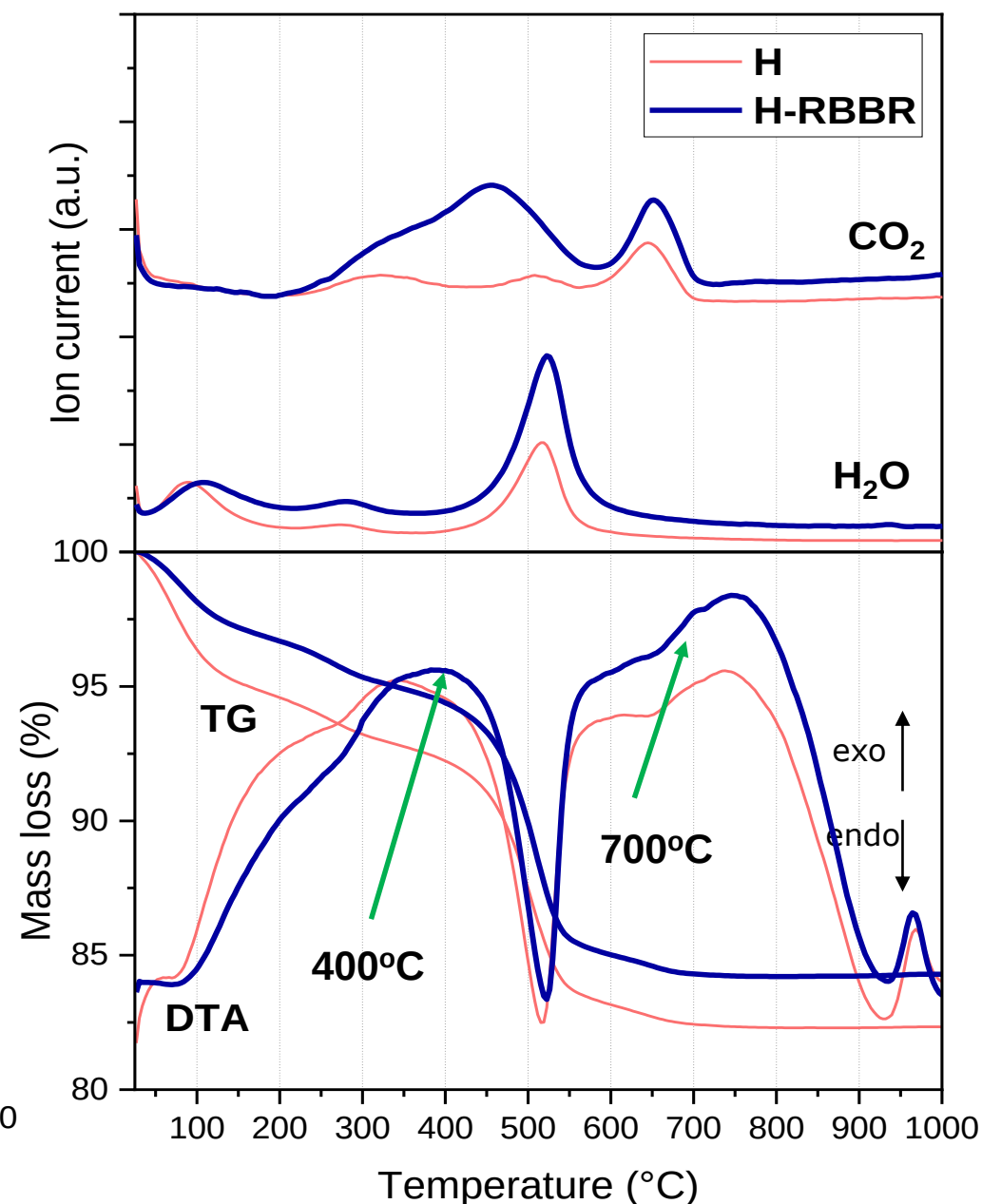
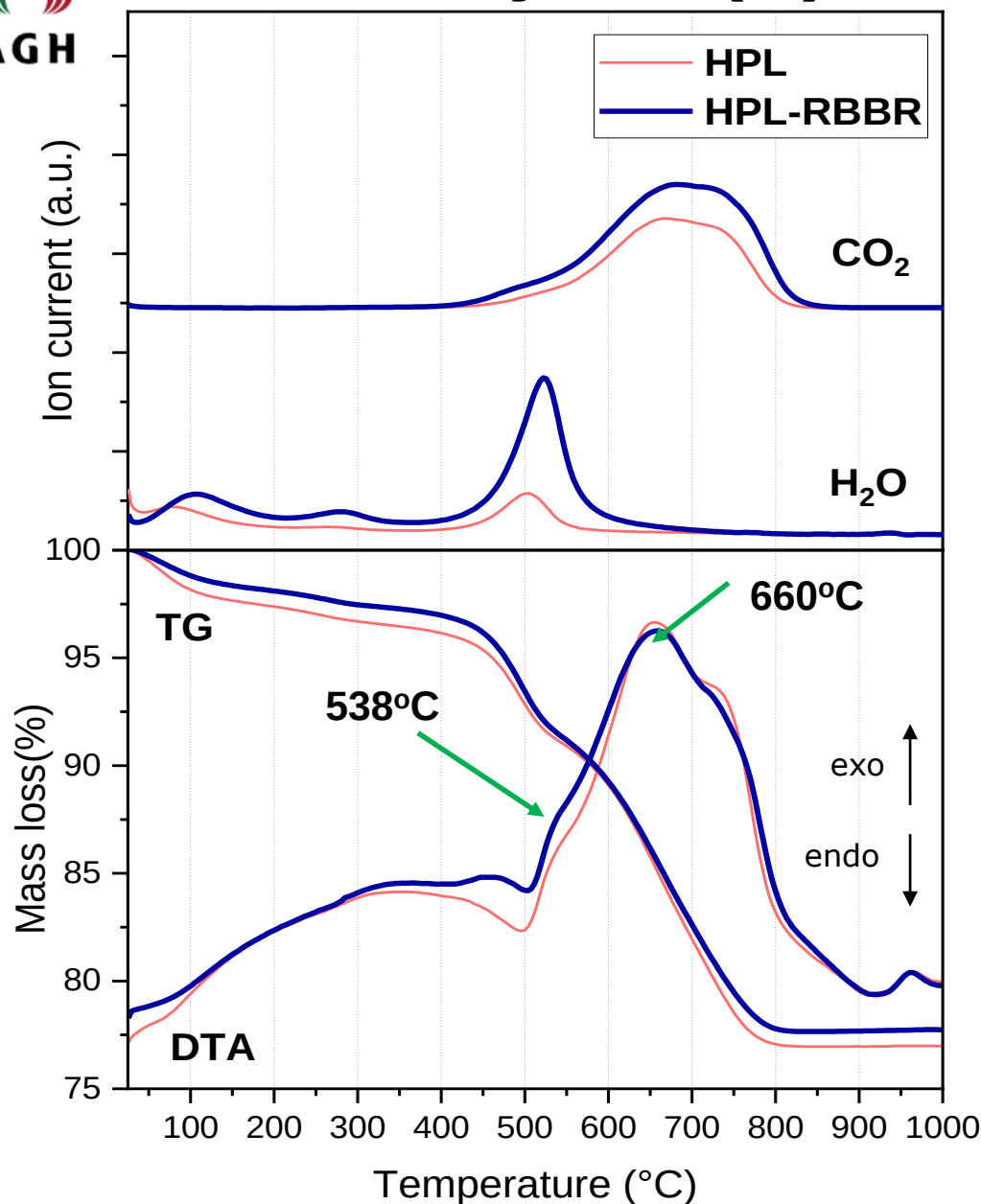


Sorption results:

HPL-RBBR	H-RBBR	PLG-RB	LG-RB
mg/kg			
4577.81	4130.07	3962.03	3723.09

the experimental conditions: initial pH-8, 100 mg/L RBBR or RB, dosage 20 g/L

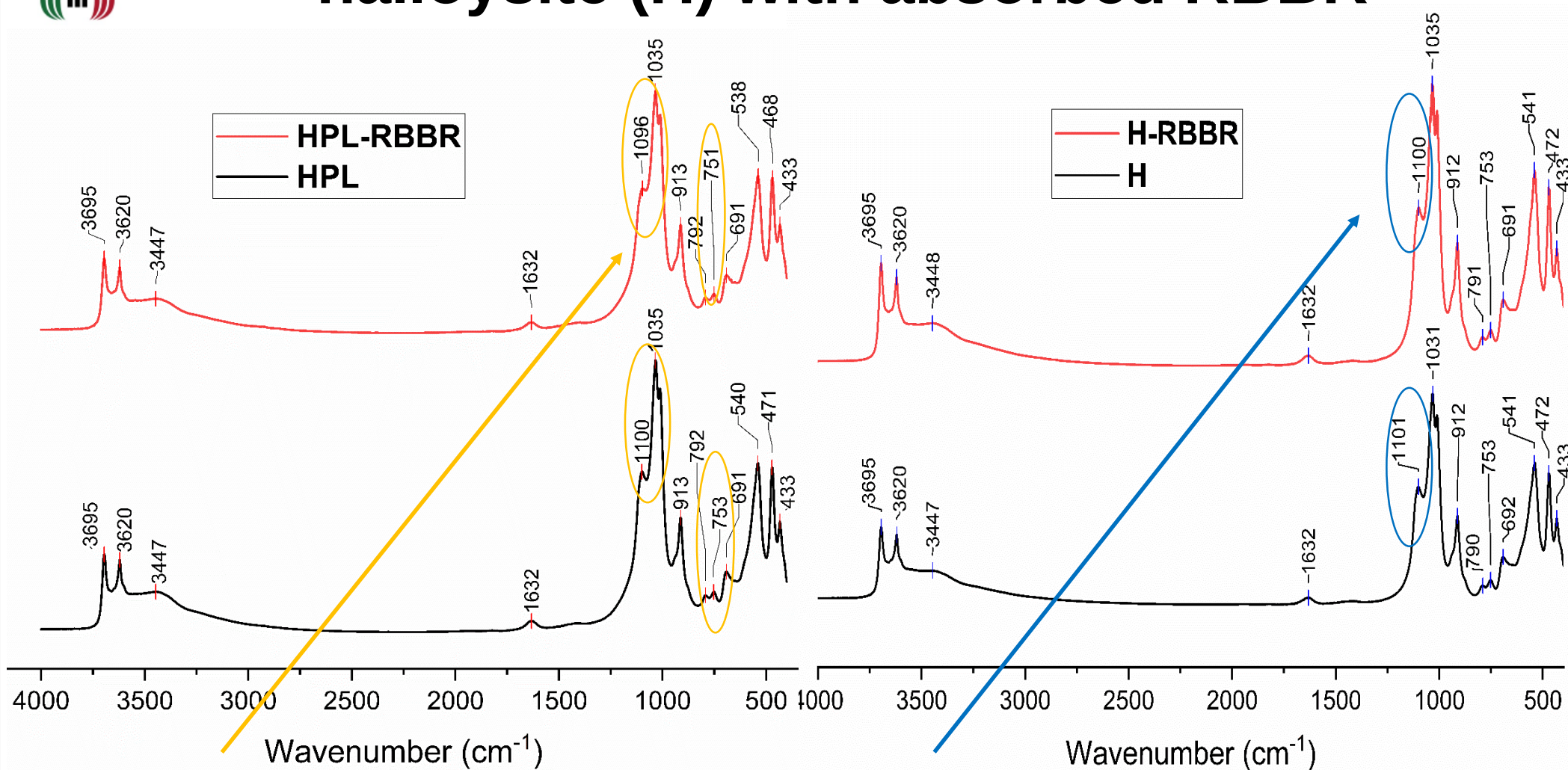
Thermal analysis: halloysite-fly ash (HPL) and halloysite (H) with absorbed RBBR



The arrows show the decomposition of RBBR on the hybrid and raw material



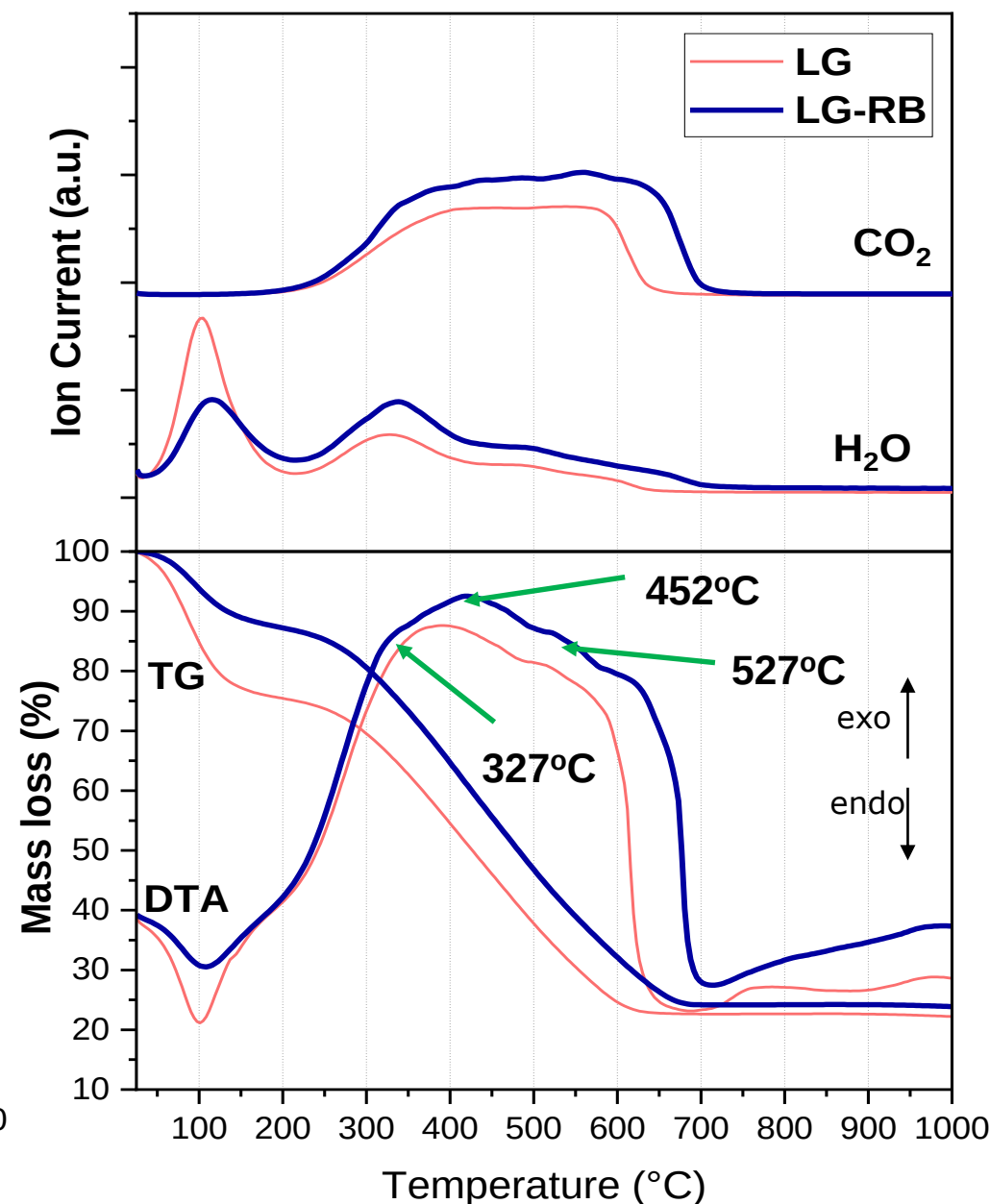
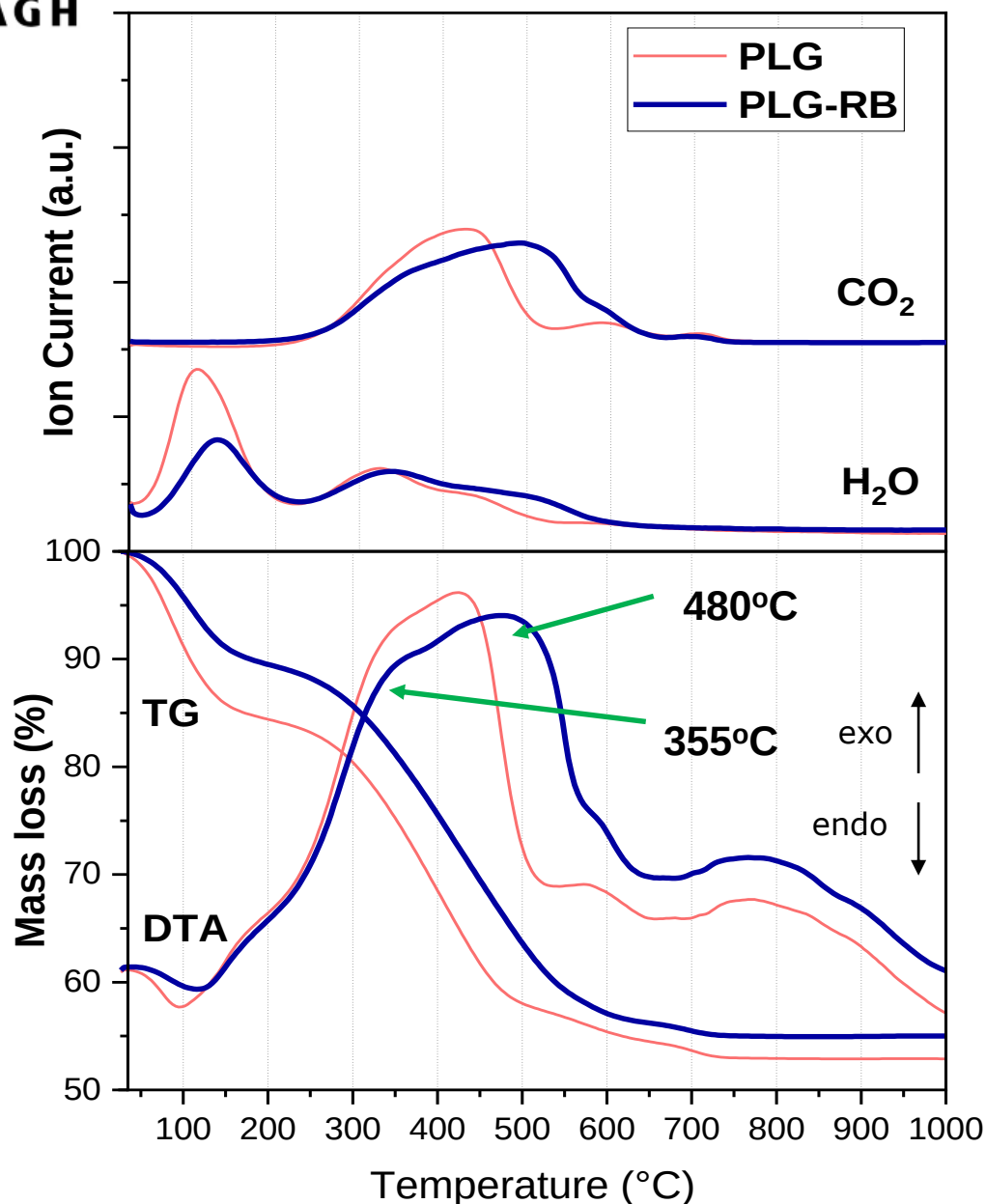
IR spectra: halloysite-fly ash (HPL) and halloysite (H) with absorbed RBBR



peaks changing caused by adsorbed RBBR (?)

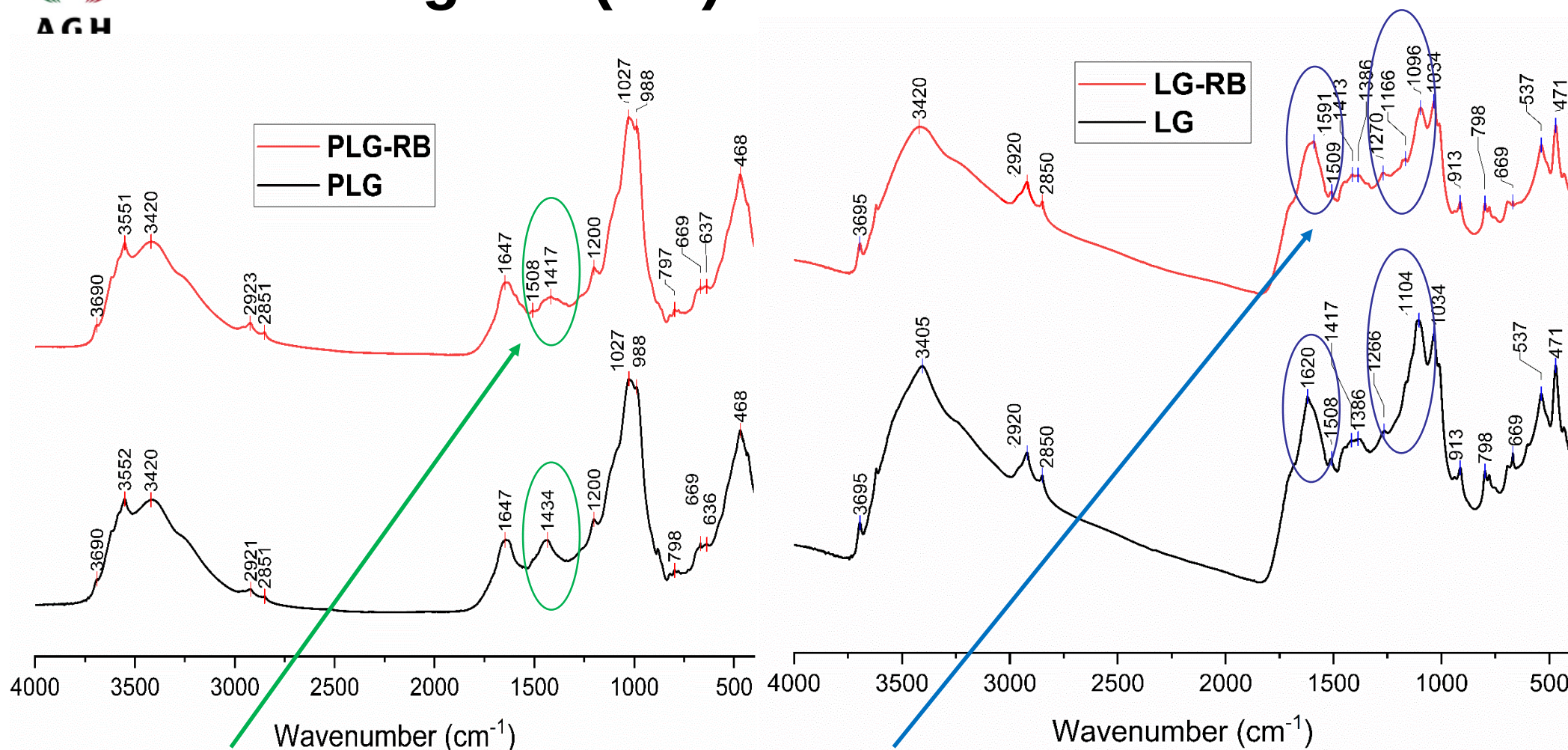
- 3700-3600 cm^{-1} - O-H stretching vibrations
- 3447 and 1632 cm^{-1} bands- adsorber water molecules
- 400- 1200 cm^{-1} - vibrations within aluminosilicate framework

Thermal analysis: palygorskite-lignite (PLG) and lignite (LG) with absorbed RB



The arrows show the decomposition of RB on the hybrid and raw materials

IR spectra: palygorskite-lignite (PLG) and lignite (LG) with absorbed RB

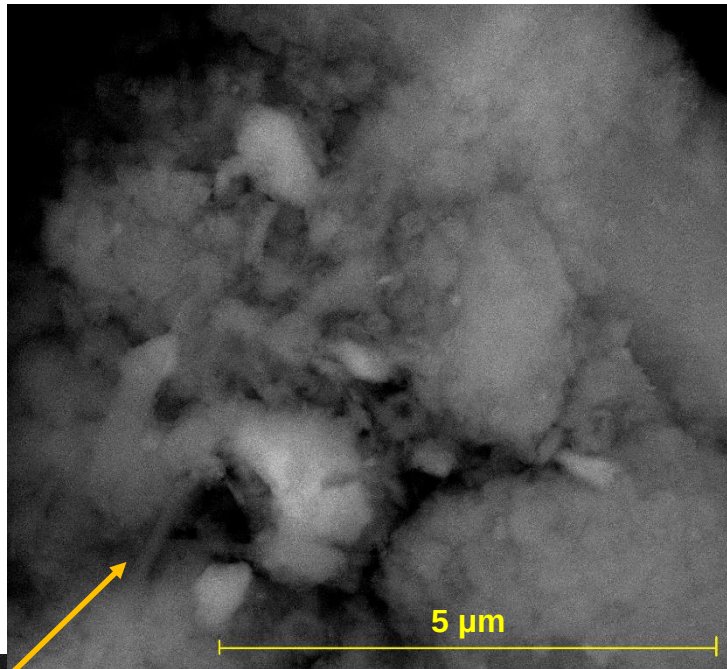


Lignite:

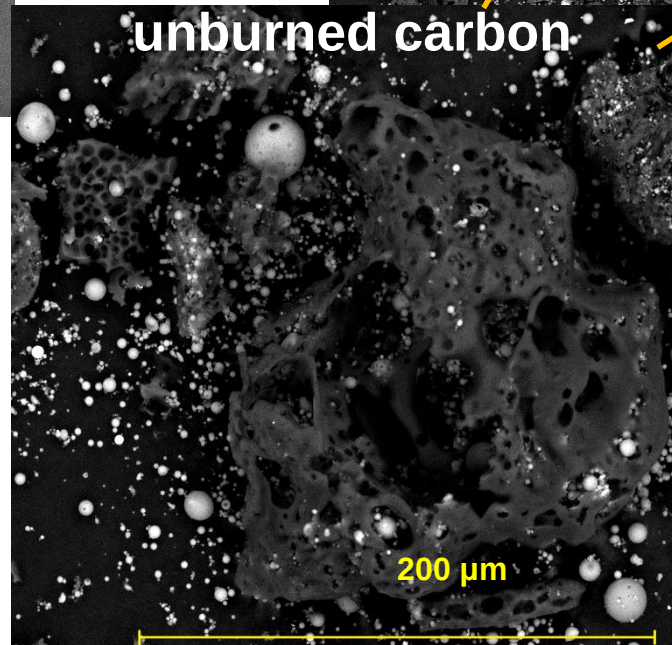
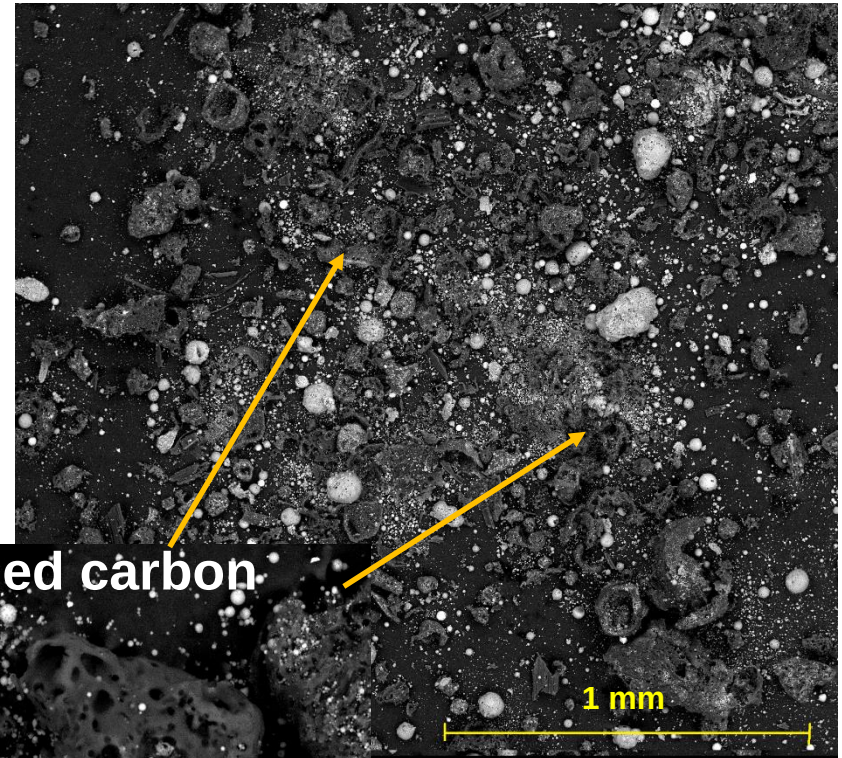
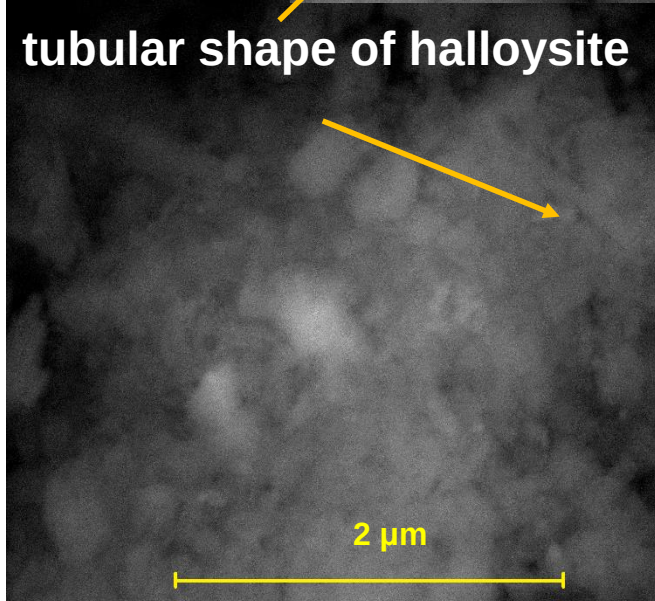
- 2800- 2920 and 1450-1370 cm^{-1} - aliphatic C-H vibrations
- 1700-1600 cm^{-1} bands- aromatic groups

- $\sim 1500 \text{ cm}^{-1}$ C=O vibrations
- 1270- 1100 cm^{-1} range - C-O vibrations
- 900-750 cm^{-1} bands- C-H groups attributed to aromatic ring

SEM images of halloysite and fly ash



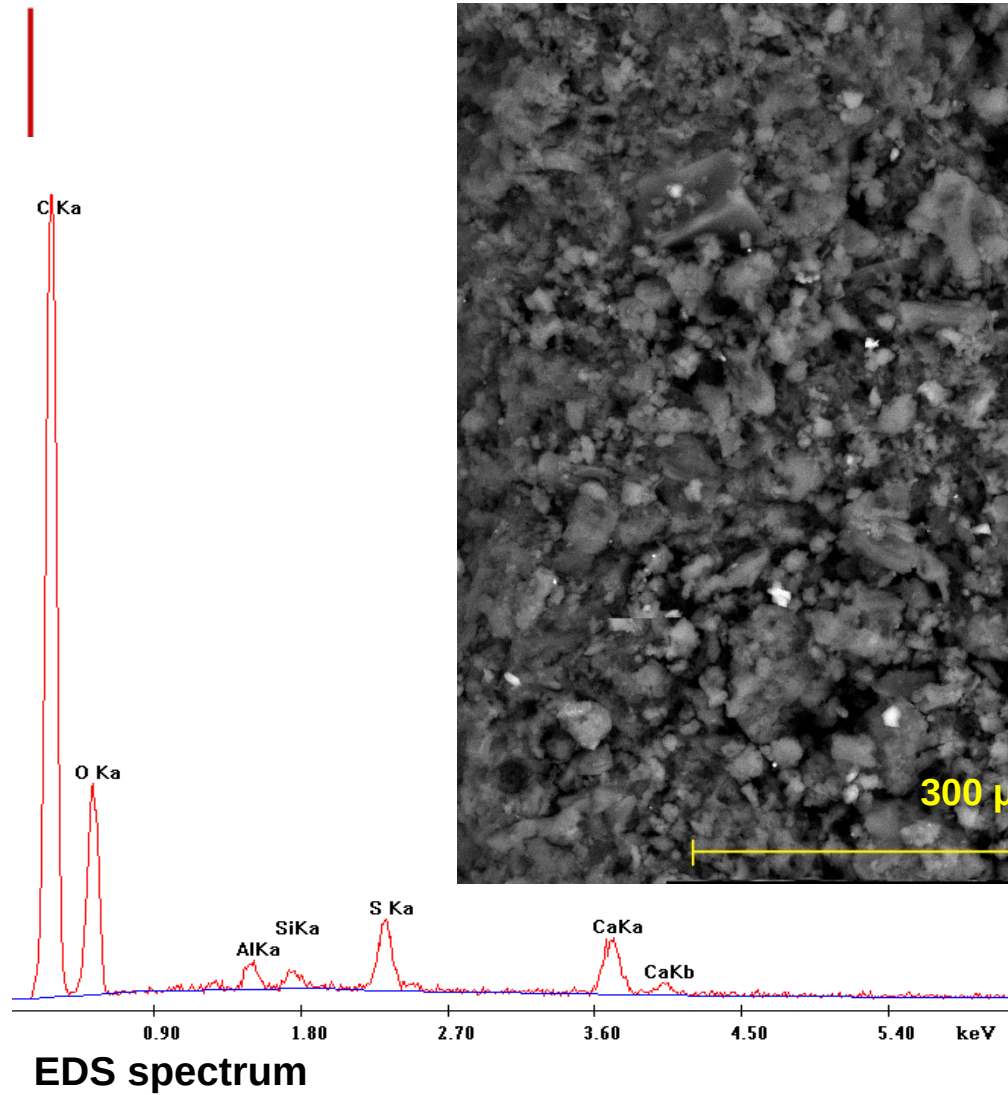
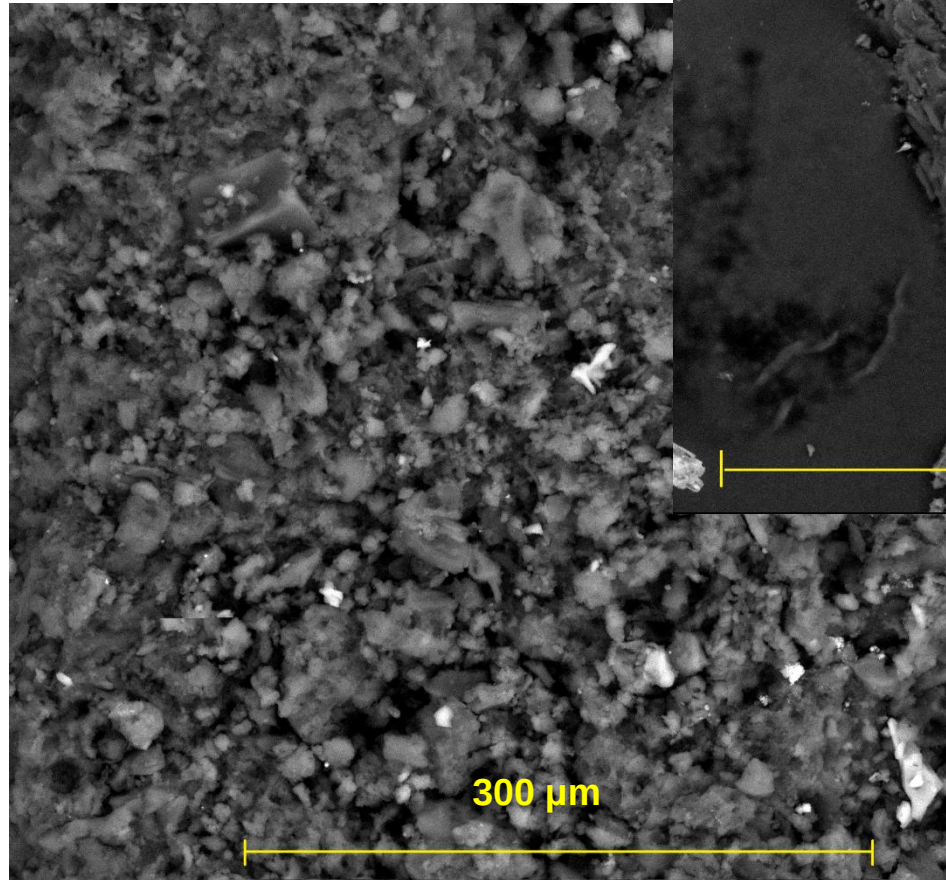
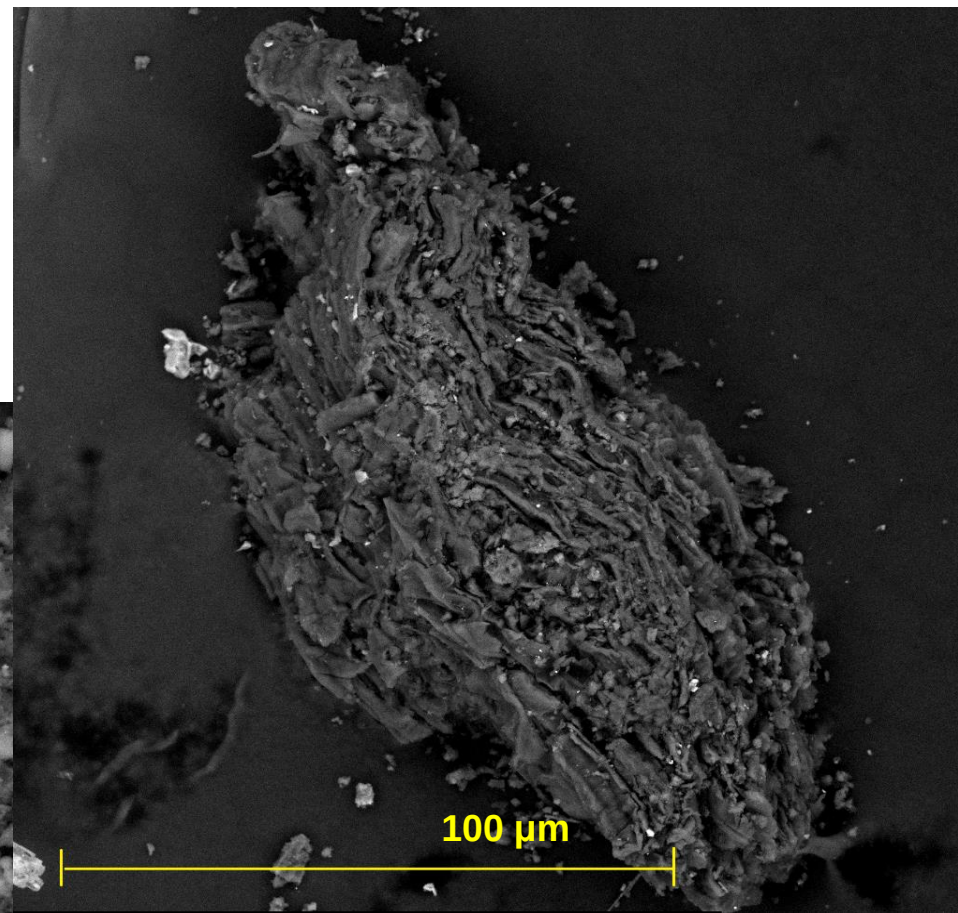
tubular shape of halloysite



CHNS analysis

elements	weight %
N	0.36
C	31.15
S	0.82
H	0.52

SEM images of lignite



Conclusions

- » the hybrid sorbents are capable for removing of dyes
- » the IR and especially thermal analysis results show that dyes molecule are uptaken onto sorbents
- » the sorbent features have important influence on their sorption properties

Conclusions

- » lignite and fly ash possess attractive sorption features: presence organic functional groups, porosity
- » halloysite and palygorskite sorption properties are caused by presence inorganic functional groups, negative surface charges, porosity
- » mixing of inorganic with organic materials leads to production of hybrid sorbents with varied sorption properties

Thank you for your attention!