

Adsorption removal of aromatic compounds from chemical enterprise's wastewater

Iryna Farbut, Iryna Kovalchuk

Institute for Sorption and Problems of Endoecology, NAS of Ukraine, Kyiv, Ukraine. mandarin3169@gmail.com

INTRODUCTION & AIM

Background The «Rubizhansky Krasitel» aniline enterprise is located in the Rubizhne city, Luhansk region of Ukraine. Heavily polluted colored wastewater of this chemical enterprise contains aromatic sulfonic acids, plasticizers, nitrobenzene, chlorobenzene, phenol, aniline, and mineral salts [1].

Problem Since 2014 due to financial predicament, the «Rubizhansky Krasitel» enterprise has almost stopped its activities and has not been monitoring groundwater. In addition, in consequence of Russia's invasion of Ukraine and hostilities, emergencies with an emergency impact on the environment may occur at the enterprise. Thus, sewage treatment is necessary, which ensures substantially complete removal and/or destruction of contaminants.

The aim of the present work was to purify the «Rubizhansky Krasitel» wastewater from organic pollutants (phenol, aniline) using carbon adsorbents with a similar porous structure.

«Rubizhansky Krasitel» wastewater



METHOD

Sorption materials

- Carbon adsorbent KARBON™ (ISPE, NAS of Ukraine) produced from commercial coconut charcoal AquaCarb 607C («Chemviron Carbon», Belgium) by high-temperature ($t=850\text{ }^{\circ}\text{C}$) steam-air activation (0.5–5.0 %, 0.5–3 h), bulk density is 0.35 g/sm^3 , $d=0.25\text{--}0.63\text{ mm}$ [2];
- Carbon adsorbent ZL-302 (Huzhou Beigang&Exp.co, LTD, China), bulk density is 0.345 g/sm^3 , $d=0.06\text{--}0.12\text{ mm}$.

Wastewater characteristics

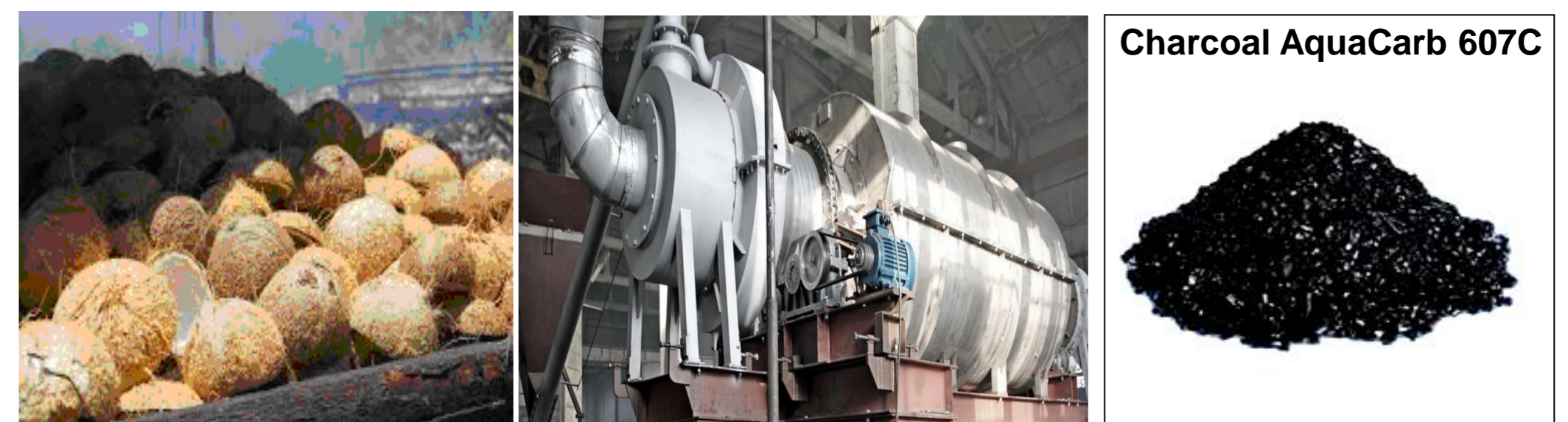
- Wastewater from «Rubizhansky Krasitel» enterprise has a $\text{pH}=4.0$, a thick dark brown color and a large amount of suspended particles;
- The organic and inorganic substances content in terms of dry residue is 98.5 g/L , the calcined residue (mineral substances) is 79.6 g/L ;
- The content of total organic carbon in the wastewater before treatment is 1130 ppm at a 1000-fold dilution;
- The total alkalinity of wastewater is 0.16 g-eq/g , the content of hydrocarbonate ions is 9.76 g/L .

Sorption experiment conditions

- The sorption experiments were carried out under static conditions in a thermostatic cell at 25°C with continuous shaking of the samples for 4 h with a 1 g sample of the sorbent with 0.025 L of the wastewater.

RESULTS & DISCUSSION

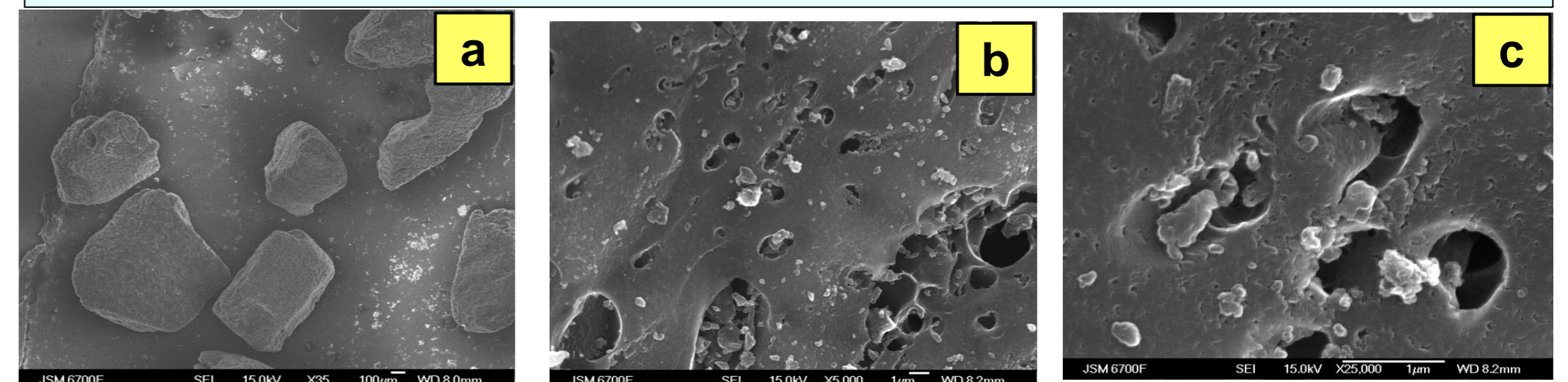
KARBON™ adsorbent production from coconut shells



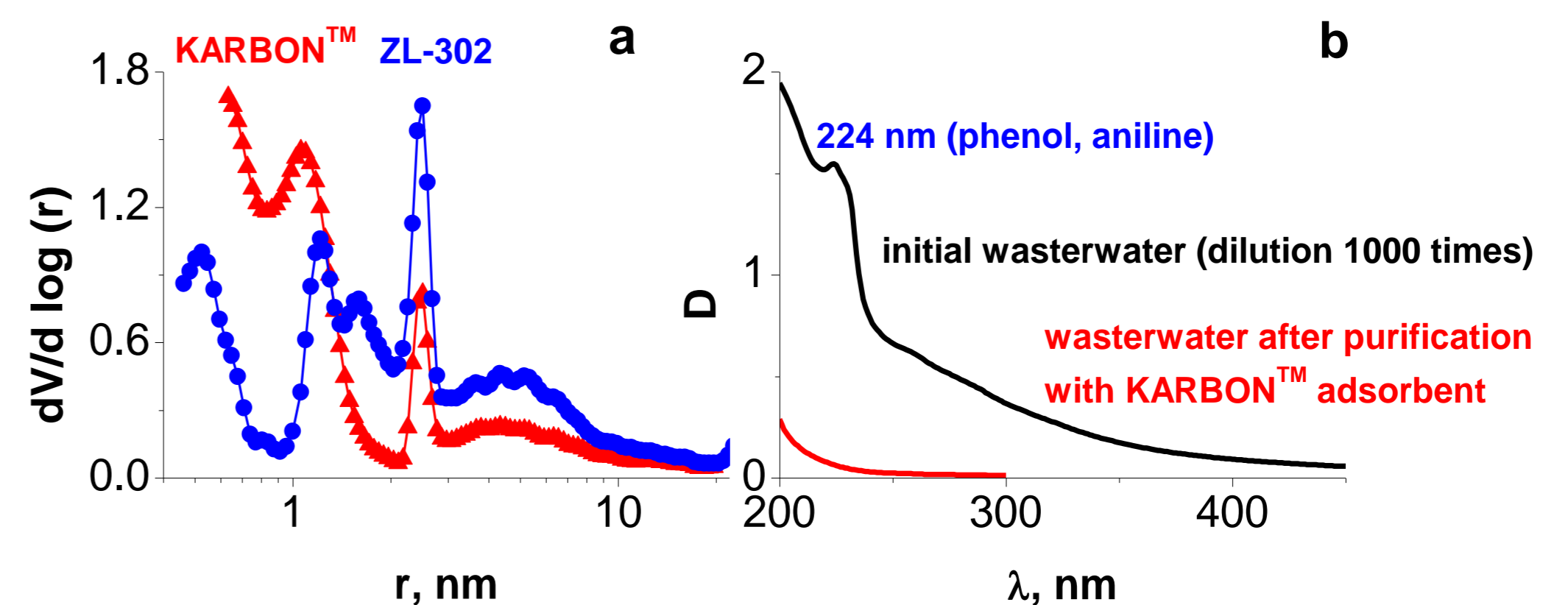
high-temperature steam-air activation

KARBON™ adsorbent

SEM micrographs of KARBON™ adsorbent with 35 (a), 5000 (b) and 25000 (c) times magnification



Pore size distributions (a) and UV-spectra of wastewater from the «Rubizhansky Krasitel» enterprise (b)



Characteristics of the carbon adsorbents

Sample	$S_{\text{sp. (BET)}}$, m^2/g	$V_{\text{tot. (BET)}}$, sm^3/g	$V_{\text{micro(BJH)}}$, sm^3/g	Microporous, %	$r_{\text{aver. (BET)}}$, nm	R, %
KARBON™	1730.0	0.92	0.76	82.6	1.1	99.99
ZL-302	1523.0	1.04	0.55	52.9	1.4	94.40

CONCLUSION

Given the availability of the raw materials, the simplicity of the obtaining method, as well as the high removal efficiency (R, %) both of aniline and phenol, carbon adsorbent KARBON™ can be used to remove aromatic compounds from the wastewater of chemical enterprises.

FUTURE WORK / REFERENCES

1. Nikolaieva I., Lenko A., Averin D., Lobodzinsky A. Doslidjennya potochnoho stanu chvostoschovyshch u Donerskii ta Luganskii oblastiach. Rezume OSCE, 2020, 51 p. <https://www.osce.org/files/f/documents/9/9/486259.pdf>.
2. Trykhlil V.A., Strelko V.V. Method of Producing of Micro- and Mesoporous Carbon Adsorbent. Pat. UA 109548, Publ. 25.08.2016, Bul. № 16/2016.