



INVESTIGATION OF ADSORPTION PROPERTIES IN CRUSHED AUTOCLAVED AERATED CONCRETE WASTE

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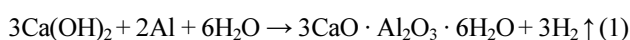
Abstract. Due to hardening in autoclaves and mechanical processing of autoclaved aerated concrete (AAC) massive, the process of production of AAC unavoidably generates waste. Up to now, there were no ways for utilisation of this type of waste. The article deals with the adsorption effectiveness of crushed autoclaved aerated concrete waste (CAACW). It was established that the ability of CAACW to adsorb certain liquids (water, diesel fuel, used engine oil) depends on viscosity of liquid which, in its turn, influences the depth of adsorption. Subject to this index, the CAACW was divided into two fractions: powder (size up to 2.50 mm) and crumbs (size from 2.50 to 10.0 mm). It was found that oil products of different kinematic viscosity are fully adsorbed by CAACW powder, i.e. diesel fuel 0.52 g/g in 18 min, and used engine oil 0.39 g/g in 1 h 15 min. The CAACW crumbs, processed by 2.00% FeSO₄ solution and dried to 3.50% of residual moisture are suitable as litter for cats. The practical use of CAACW will help us solve two important environmental problems: on the one hand – to recover the industrial waste, on the other – to prevent ground pollution by effused oil products.

Keywords: autoclaved aerated concrete, industrial waste, sorbents, sorption properties, calcium hydrosilicates, macro-structure, oil products, litter for cats.

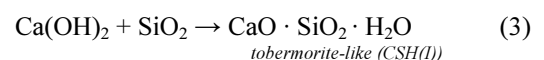
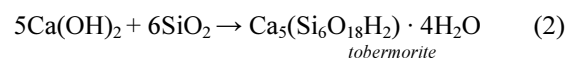
1. Introduction

Sorbents play an important role in many chemical processes. They are used in desiccation, catalyst, separation, purification and other processes (Rouquerol *et al.* 1999; Mažeikienė *et al.* 2008; Baltrėnas, Zagorskis 2009; Valdberg, Polienova 2010; Sokolov *et al.* 2010). The literature sources often write about the production of sorbents from various industrial wastes (Johannes 1995; Bhatnagar, Sillanpää 2010; Ho, Shih 1992; Pelovski *et al.* 2003). This enables the reduction of sorbent costs and helps resolving problems in industrial waste utilisation. One type of such aforementioned industrial wastes that can perform the function of sorbents comes from autoclaved aerated concrete (AAC).

AAC is produced from the formative mixture consisting of binding material (ordinary lime, or lime mixed with Portland cement), filler (milled quartz sand), solvent (water) and gas producing agent (usually, aluminium paste). Portland cement is used in AAC to improve the operational properties such as frost resistance, durability and etc. Slacking lime raises temperature of the AAC formative mixture. At the same time, aluminium paste reacts with lime, resulting in release of hydrogen gas:



The generated hydrogen gas inflates AAC forming mixture, which is later hardened isothermally (temperature 180 °C, pressure 1.0 MPa) for 8 hrs in saturated water steam environment inside the autoclave. This process allows producing tobermorite and tobermorite-like calcium hydrosilicates, which provide ACC with strength (Mitsuda *et al.* 2005; Haas 2005):



Subsequent to inflation of the formative mixture and its treatment in the autoclave, a very porous material, consisting of opened and closed pores (the total porosity varies from 60% to 90% with the average diameter of pores of approx. 1.0 mm) is produced (Haas 2005; Sinica *et al.* 2004). On the other hand, the aforementioned pores are separated by solid material (calcium hydrosilicate) which has microporous structure. The character of AAC structure is showed in Fig. 1.

In AAC production, man-caused waste generates, i.e. strips of 30 to 50 mm in thickness, which remain on the bottom of the pallet after massive cutting. It is known (Sinica *et al.* 2004) that AAC samples of porous structure, which are meant for determination of life time, can

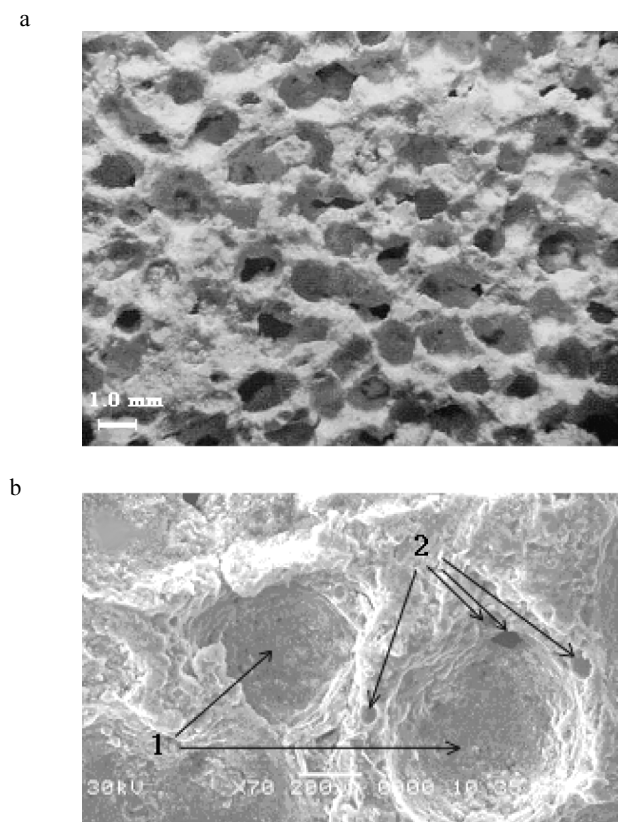


Fig. 1. The character of AAC structure: a – macrostructure (Sinica *et al.* 2005), b – microstructure (1 – pores, 2 – micro-pores) (Sinica *et al.* 2004)

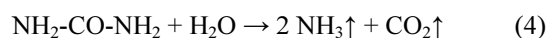
adsorb up to 75% of water within 48 hrs depending on density and structure of the material. Within a longer time-period, the water adsorption can reach 100% and even more (Kus *et al.* 2004). The authors (Ioannu *et al.* 2008) who tackled theoretical aspects of this phenomenon paid particular heed to structural aspects of partitions between pores, which predetermine the capillary adsorption of water.

The insoluble porous materials of organic and inorganic origin are characteristic of good adsorption properties, i.e. they can retain liquids on their surface, in pores and capillaries (Baltrėnas, Vaišis 2005; Johannes 1995; Bhatnagar, Sillanpää 2010; Baltrėnas, Vaišis 2007). The advantage of inorganic sorbents (expanded perlite (Teas *et al.* 2001), modified quartz sand (GWP Consultants LLP 2009; Mofa *et al.* 2003), zeolite (Armbruster 2001; Wang, Peng 2010), calcium and magnesium carbonates and their oxides (Sayed *et al.* 2004), synthetic calcium hydrosilicates (Denafas *et al.* 1999; Martirosyan *et al.* 2002)) is in the fact that they are incombustible and can be used for adsorption of oil products. As the most common method for utilisation of oil products is burning, the aforementioned materials can be used as additives in cement industry (Otaigbe, Egiebor 1991; Wang *et al.* 2009).

The ability of AAC to adsorb water stems from 1981, with the suggestion to produce porous sorbents out of mixture consisting of quartz sand, lime, small quantity of foamer and water, which is processed hydrothermally

in an autoclave (Krämer, Follmann 1981). However, there are no data reported about the adsorption properties of CAACW and the rate of its adsorption. This information is necessary in order to decide how fine CAACW should be, subject to viscosity of planned to adsorb liquid and the rate of liquid adsorption.

Authors (Sazhnev *et al.* 2010) recommend using the crushed AAC as litter for cats as well. It is known that with application of mixed binding material (lime and cement) for AAC production, the cement minerals do not fully hydrate during the hardening in autoclave (Rossetti *et al.* 1973). Subsequent to hardening, further hydration of cement minerals takes place in moist environment, which also results in release of free lime (Akaiwa, Sudoh 1966). Using the CAACW of such composition as litter for cats, i.e. during their contact with urine (temperature of approx. 39 °C), the alkaline medium forms where ammonia is released from carbamide contained in urine (Premanode, Toumazou 2007):



For this reason, the use of CAACW as litter for cats is limited. Besides, it is also important to select an appropriate granulometric composition of CAACW, as very fine crumbs can stick to cat soles and would be spread over the premises.

Considering the sorption properties of CAACW, the study aims to determine the optimal size of particles of CAACW to be used as sorbents for liquids of different viscosity and modify CAACW for use as litter for cats.

2. Materials and methods

2.1. Materials

For investigation as sorbents, CAACW processed in the laboratory with jaw-breaker SHD 6 by Vibrotechnic (Russia) was used. pH of water extract of CAACW was 9, and the content of free lime varied from 0.14 to 0.30%. Their granulometric composition and bulk density are provided in Table 1.

Basing on the received results regarding adsorption depth of different liquids by AAC samples, provided in chapter 3.1., two kinds of fractions of CAACW were used: CAACW powder (up to 2.5 mm in size) and CAACW crumbs (2.5 to 10 mm in size).

The ability of CAACW to adsorb various liquids (water, diesel fuel and used engine oil) was determined by comparison with the sorbent Naftolakis[®] produced by the private company Biocentras (Lithuania); and the ability to absorb water was compared with the analogical ability of the following cat litters: Finko[®] by Akvatara (Lithuania), Natural[®] by Lith (Czech Republic) and Nature Cat Gold[®] by Tolsa Beneluy (Belgium). The granulometric character of the aforementioned materials is provided in Fig. 2.

The physical properties pertaining to adsorption of liquids are provided in Table 2.

Dechromator powder (used in the cement industry for reduction of chromates) (TY Y 24.1-05766356-053:2005) – which is waste from metallurgical industry

that contains approx. 30% of FeSO₄ – was used for neutralization of CAACW crumbs. The aqueous suspension of 5.0% (that corresponds to the solution of 2.0% FeSO₄) with pH 3.2 was used. After neutralization, CAACW medium was determined by 1.0% alcoholic phenolphthalein solution.

Table 1. Granulometric composition and bulk density of CAACW

Size of particles in mm	Quantity in mass %	Bulk density in dry state in kg/m ³
5.000–10.00	6.20	385
2.500–5.000	21.5	410
1.250–2.500	13.0	420
0.630–1.250	0.80	450
0.315–0.630	16.5	475
0.140–0.315	2.00	480
< 0.140	17.0	490

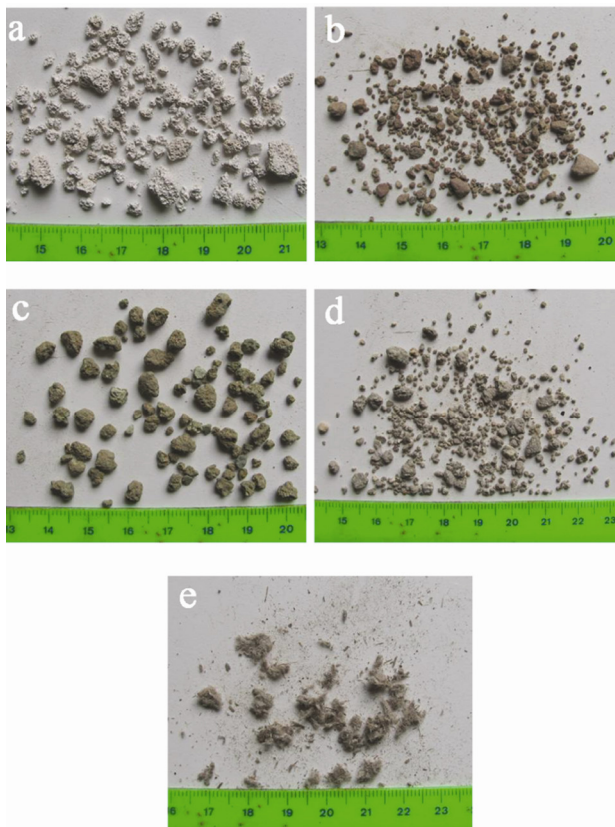


Fig. 2. Granulometric character of different materials used as sorbents or litter for cats: a – CAACW, b – litter for cats FINKO®, c – litter for cats NATURAL®, d – litter for cats NATURE CAT GOLD®, e – sorbent NAFTAOLAKIS®

Table 2. Kinematic viscosity and density of liquids at temperature of 20 °C (Guthrie 1960)

Liquid	Viscosity in cSt	Density in g/cm ³
Water	1.002	0.998
Diesel fuel	4.460	0.820
Used engine oil	58.05	0.890

To modify the surface of CAACW crumbs, the surfactant powder Ufapore TCO® by Unger (Norway) was used with pH = 8 of aqueous solution and the content of active material of 94%.

2.2. Testing methods

Adsorption by AAC samples. To determine liquid adsorption, dry AAC samples in the shape of a prism with 50 mm in height and area of soaking 20×20 mm were used. The samples were immersed into investigated liquid at a depth of 1 mm, and water was constantly added to keep the same depth of immersion. The scheme used for the test is provided in Fig. 3.

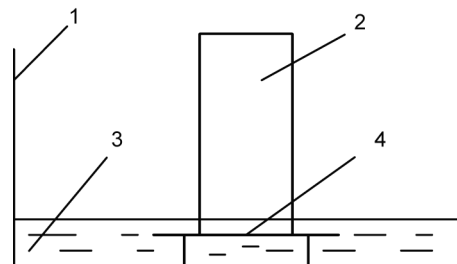


Fig. 3. Test scheme for determination of nature of liquid adsorption: 1 – container, 2 – AAC sample, 3 – liquid, 4 – tray

The depth of liquid adsorption was determined by measuring the height of adsorption in samples, in two intervals: each 15 min for used engine oil and 2.5; 5; 10; 12 and 60 min for water. Afterwards, the samples were cut in half (height-wise) and the depth of liquid adsorption was measured on the surface.

Macrostructure. The tests of macrostructure were performed soaking AAC samples or CAACW in respective liquids and with the help of the optical microscope K-400L by Motic (China) with maximal magnifying x100. The tests of macrostructure consist of the subsurface distribution of adsorbed liquid in the AAC samples, the nature of liquid distribution in pores (subject to density and viscosity of liquid) and the effectiveness of modification of CAACW surface. Characteristic areas of AAC samples and CAACW were fixed by the image capture hardware “Pixera PVC 100C”.

Adsorption by CAACW. As it was mentioned before, the CAACW adsorption, subject to viscosity of different liquids, was investigated in the form of two fractions: powder and crumbs. The method used for assessment of sorbent effectiveness was analogical to the known methods (SAIC Canada 2003), which are based on change of sorbent mass during a unit of time. The test equipment is provided in Fig. 4.

The test is performed in the following way: 100 g of investigated sorbent (2) is poured into the strainer (3), and then the container (4) is filled with the liquid meant for adsorption to such level that the bottom of the strainer is immersed at a depth of 5 mm and that during adsorption, the level of liquid is constantly added. Once liquid reaches the sorbent in the strainer, the electronic balances (1) KERN EG 4200-2NM by Kern&Sohn GmbH (Ger-

many), with accuracy of 0.01 g are used to measure the change in the sorbent mass, as well as the rate of adsorption of respective liquid and its full adsorption.

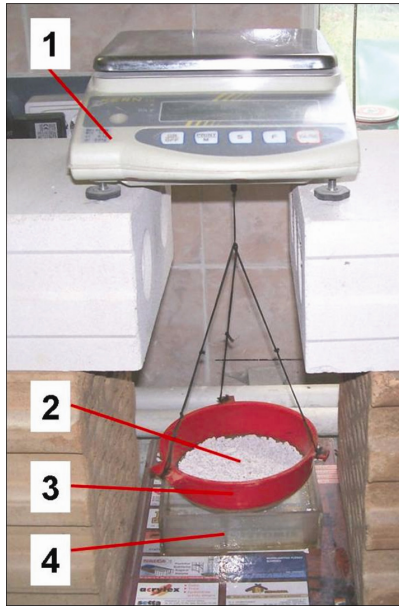
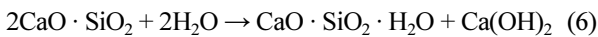
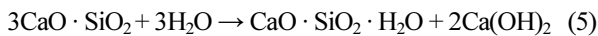


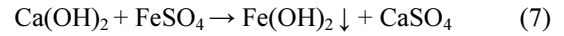
Fig. 4. Equipment for testing of effectiveness of sorbents: 1 – electronic balances, 2 – sorbent, 3 – container with strainer, 4 – container for liquid

Neutralization of CAACW crumbs. As the formative mixtures of AAC hydrate contains Portland cement minerals (tri- and di-calcium silicates), free Ca(OH)_2 is released during these processes (Taylor 1997):



Hydration of Portland cement minerals starts even before AAC forming mixtures are treated in an autoclave; and intensifies during the process. As after 8 hrs treatment in an autoclave (temperature 180 °C, pressure 1.0 MPa) insignificant quantities of non-hydrated minerals of Portland cement still remain in the hardened AAC, small quantities (0.14–0.30%) of free Ca(OH)_2 in fully hydrated AAC samples (or CAACW) are found (Rossetti et al. 1973). After CAACW contact with different liquids (for example water or urine), OH^- ions from free Ca(OH)_2 determine the alkalinity of the generated media. As it was mentioned in description of the reaction (4), alkaline medium leads to an undesirable release of ammonia from urine. For this reason, the CAACW was neutralized (Chichibabin 1963).

To neutralize CAACW crumbs, they were mixed with 5.0% aqueous suspension of dechromator. For this purpose, a container of the mini magnetic stirrer R1000 by Roth (Germany) was filled with 100 ml of suspension and 5 ± 0.1 g of CAACW crumbs; the mixture mixed for 15; 30; 45 and 60 seconds at a rate of 100 rpm. During the neutralization, the reaction occurs between free Ca(OH)_2 contained in CAACW crumbs and suspension of dechromator:



After each mixing, CAACW crumbs were separated and rinsed 3 times in distilled water in order to remove insoluble and low-soluble particles that formed during mixing, as well as non-reacted remains of the suspension. Out of processed CAACW crumbs, a puree consistency sample was prepared. If 1–2 drops of phenolphthalein indicator coloured the samples in violet, then the CAACW crumbs were mixed further, prolonging the mixing by extra 15 s until they no longer changed colour (remained colourless) after an application of the indicator.

Modification of CAACW crumbs. Modification of the surface of CAACW crumbs (removal of very fine particles (dust) from the surface) was performed mixing neutralized crumbs with the 0.02% aqueous solution of surfactant Ufapore TCO® in the aforementioned magnetic stirrer for 30 s keeping at the same rate of mixing and the same water–solids ratio as in the analogical neutralization procedure.

3. Results and discussion

3.1. Adsorption by AAC samples

At the initial stage, the nature of liquid adsorption by AAC samples was investigated. The adsorption of used engine oil by AAC samples was determined both on the exterior and interior parts of prisms. The received data is provided in Fig. 5 and the kinetics of adsorption are given in Fig. 6.

The analogical tests were carried out with diesel fuel and ink-coloured water. For insufficient difference in colour between adsorbed and dry parts of AAC samples, the graphical representation of adsorption kinetics is presented in Fig. 7.

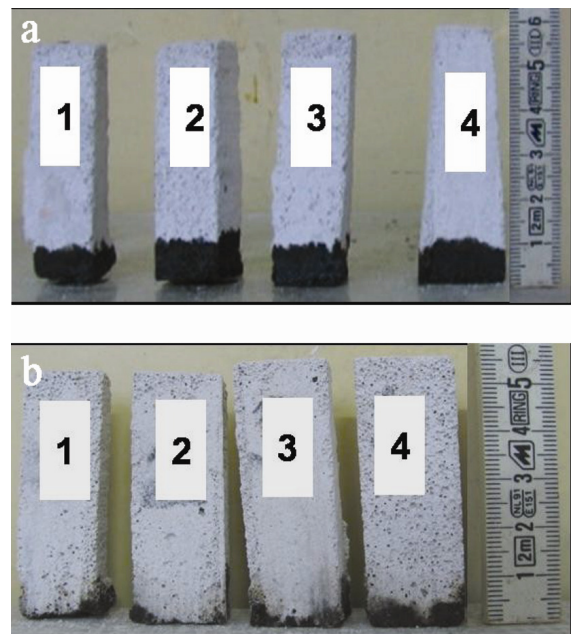


Fig. 5. Adsorption of used engine oil by AAC samples: a – the exterior, b – the interior. After 1 – 15, 2 – 30, 3 – 45, 4 – 60 min

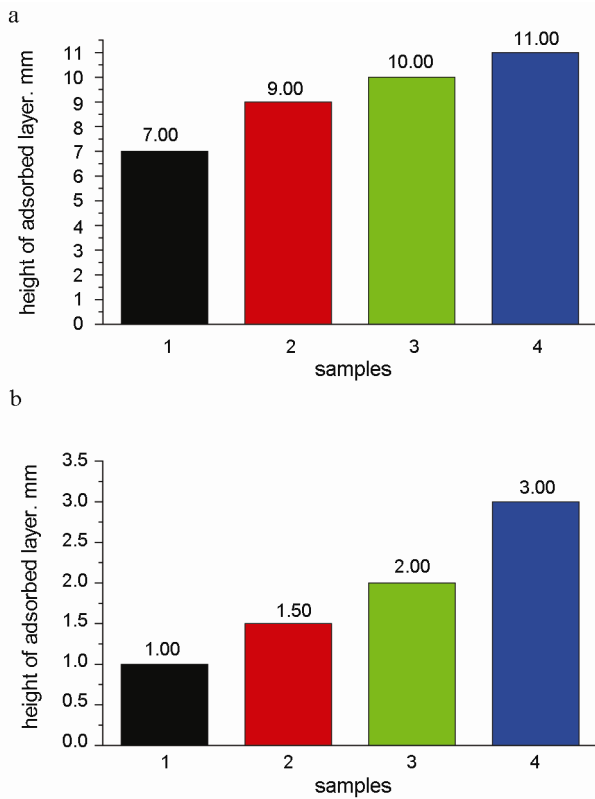


Fig. 6. Adsorption of used engine oil by AAC samples: a – outside, b – inside. After: 1 – 15, 2 – 30, 3 – 45, 4 – 60 min

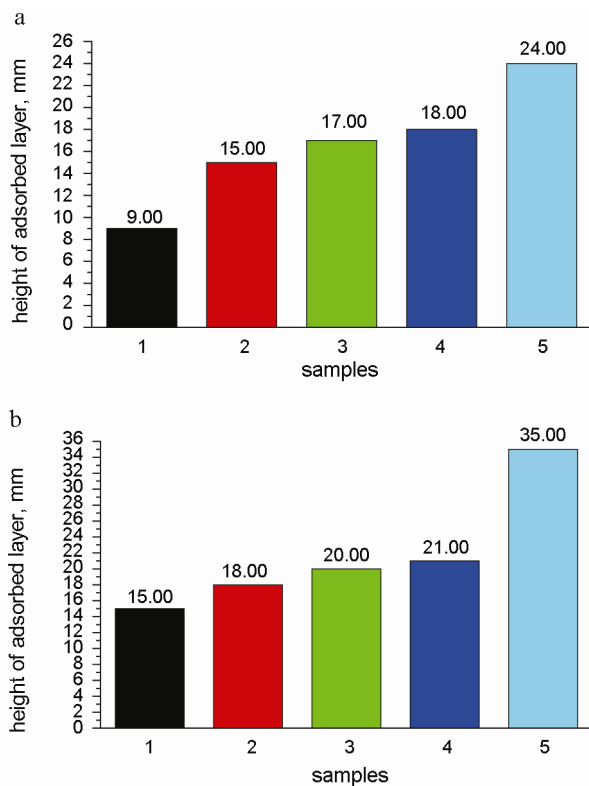


Fig. 7. Adsorption by AAC samples: a – diesel fuel, b – ink-coloured water: After: 1 – 2.5, 2 – 5.0, 3 – 10, 4 – 12, 5 – 60 min

Subsequent to assessment of adsorption of liquids characteristic to AAC samples, one can state that these samples adsorb water and diesel fuel equally on the surface and the interior. In this case, the migration of liquids through walls between pores, the structure of which consists of micropores connected by capillaries and mutually connected pores, happens analogically on the surface of AAC samples and inside them, regardless of the fact that liquids fully push out the air from inner pores. The viscous liquid (in this case – engine oil) was not equally adsorbed by AAC samples. The exterior surfaces of AAC samples adsorb the viscous liquid quicker than the interior of these samples. This can be explained by the fact that the forces of coherence between liquid and AAC are greater than those between mutual relationships between liquid molecules. As the interior surface from open pores attracts molecules of viscous liquid, they enter. Meanwhile, the capillaries and micropores contained in the inner partitions of AAC samples are filling up with liquid and do not allow the liquid to migrate via microcapillaries.

3.2. Adsorption by CAACW

The values of adsorption by CAACW crumbs and CAACW powder are provided in Fig. 8 and Fig. 9.

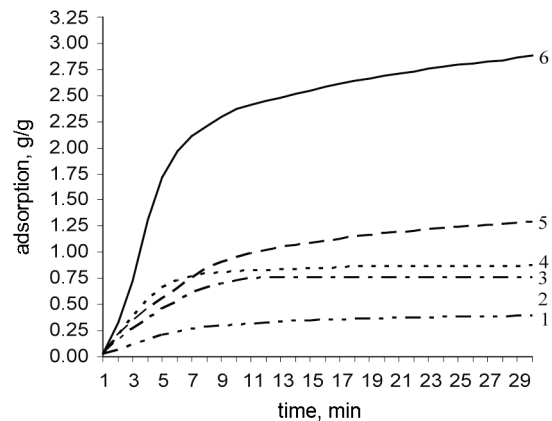


Fig. 8. Adsorption kinetics of higher viscosity liquids by different materials: 1 – CAACW crumbs (used engine oil), 2 – CAACW crumbs (diesel fuel), 3 – CAACW powder (used engine oil), 4 – CAACW powder (diesel fuel), 5 – sorbent NAFTOLAKIS® (used engine oil), 6 – sorbent NAFTOLAKIS® (diesel fuel)

The results of performed tests (Fig. 8) show that the liquids of higher viscosity (diesel fuel or used engine oil) are adsorbed more effectively by CAACW powder (Fig. 8, curves 3 and 4). By comparison of inorganic CAACW crumbs with organic sorbent NAFTOLAKIS®, one can state that the adsorption rate of CAACW crumbs and the aforementioned sorbent is approximately equal, however, the values of their adsorption differ. This means that for adsorption of the same amount of liquid, the 2.5 times greater amount of CAACW powder is required. The saturation of CAACW with liquids, as described in literature (Mačiulaitis, Žemaitytė 1999), firstly takes place through pores with the open surface. Latter, liquids migrate into

closed CAACW pores through micropores and capillaries, which exist in the partitions between the pores.

The provided curves (Fig. 9) show that the CAACW crumbs (Fig. 9 curve 1) adsorb water more effectively than some types of litter for cats presently available on the market (Fig. 9 curves 2–4).

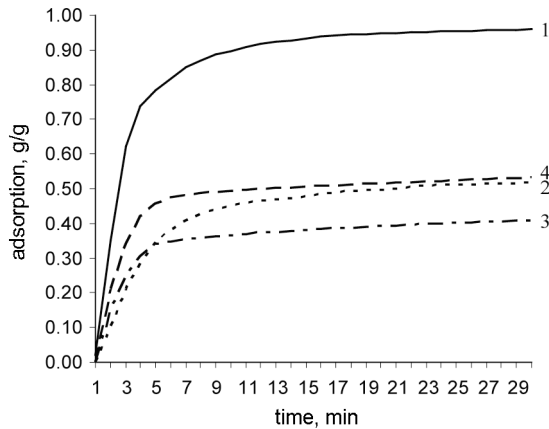


Fig. 9. Adsorption kinetics of water by different materials: 1 – CAACW crumbs, 2–4 – litters for cats: 2 – FINKO[®], 3 – NATURAL[®], 4 – NATURE CAT GOLD[®]

While considering the nature of liquid adsorption, we can observe that the value of water adsorption by CAACW crumbs reaches 100% of their mass. Meanwhile, the adsorption by CAACW powder exceeds the value of its mass. This phenomenon can be explained by adsorptive properties of CAACW powder and its ability to retain liquid on its surface, in the pores or capillaries and spaces in between (Fig. 10).

3.3. Investigations of macrostructure

The adsorption of higher viscosity liquids inside the AAC samples happens slower at an initial stage when the pores are filled up; and only then the liquid penetrates through walls between the pores (Fig. 11a and b).

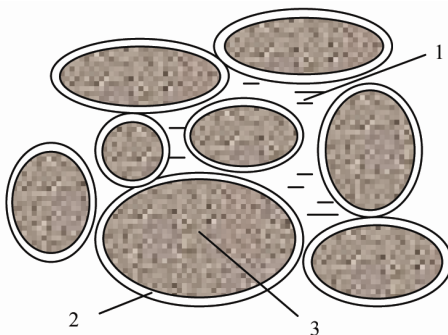


Fig. 10. Scheme of full absorption of oil products: 1 – liquid entrapped by CAACW powder, 2 – liquid adsorbed on the surface of CAACW powder, 3 – CAACW powder saturated with liquid

The received results showed that for adsorption of viscosity liquids, CAACW powder is the most suitable, as it has a greater exterior surface. Meanwhile, for adsorption of lower viscosity liquids, the CAACW crumbs can be used.

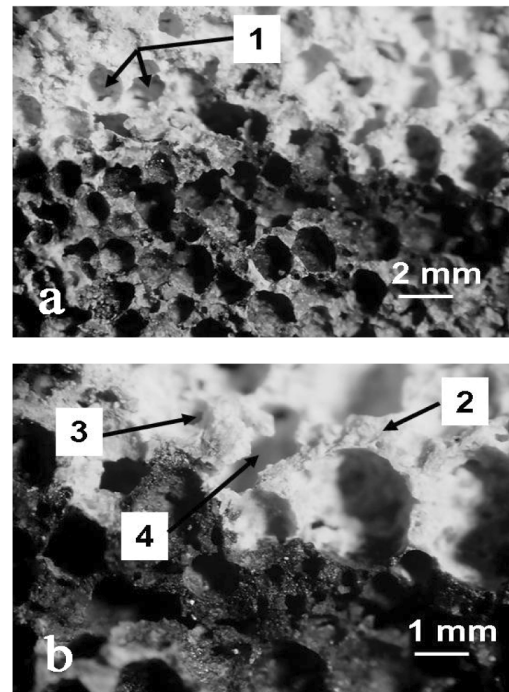


Fig. 11. Distribution of higher viscosity liquids in an AAC sample: a – in the transition zone of adsorption, b – in the walls between pores: 1 – pores, 2 – wall between pores, 3 – micropores, 4 – capillaries

The moisture of CAACW is also important. After autoclave hardening, the moisture of AAC reaches up to 35.0% of its mass. Thin AAC stripes dry fast and their moisture decreases; and after crushing, they continue drying with water vapour migrating inside all the time. The drying intensity of CAACW depends on relative moisture of the environment, quantity or granulometric composition and conditions of their storage.

Our investigations were performed with dry AAC samples, CAACW crumbs and CAACW powder. However, the balance adsorption moisture of AAC, subject to relative moisture of the environment, varies from 1.50 to 5.00%. Taking this into consideration, we propose residual moisture of 3.50% in using CAACW to be used as a sorbent. In this case, their adsorption ability, i.e. quantity of adsorbed liquid, decreases respectively.

Neutralization of CAACW crumbs revealed that subsequent to neutralization, the reaction between the FeSO_4 solution and free lime continues during its soaking. The results of investigations showed that the coarsest CAACW crumbs (size about 10 mm) after mixing in the suspension of dechromator for 45 s are fully neutralized in the presence of the maximal quantity of free lime. On the other hand, upon mechanical crushing of AAC, the fine particles and dust accumulate in the pores (Fig. 12a).

After neutralization, residues of $\text{Fe}(\text{OH})_2$ and CaSO_4 products and non-soluble ballast of dechromator suspension accumulate (Fig. 12b). To avoid residues of non-soluble ballast of dechromator suspension in the process of neutralization, the transparent solution of

FeSO_4 was used as received from the dechromator suspension after decantation (Fig. 12c).

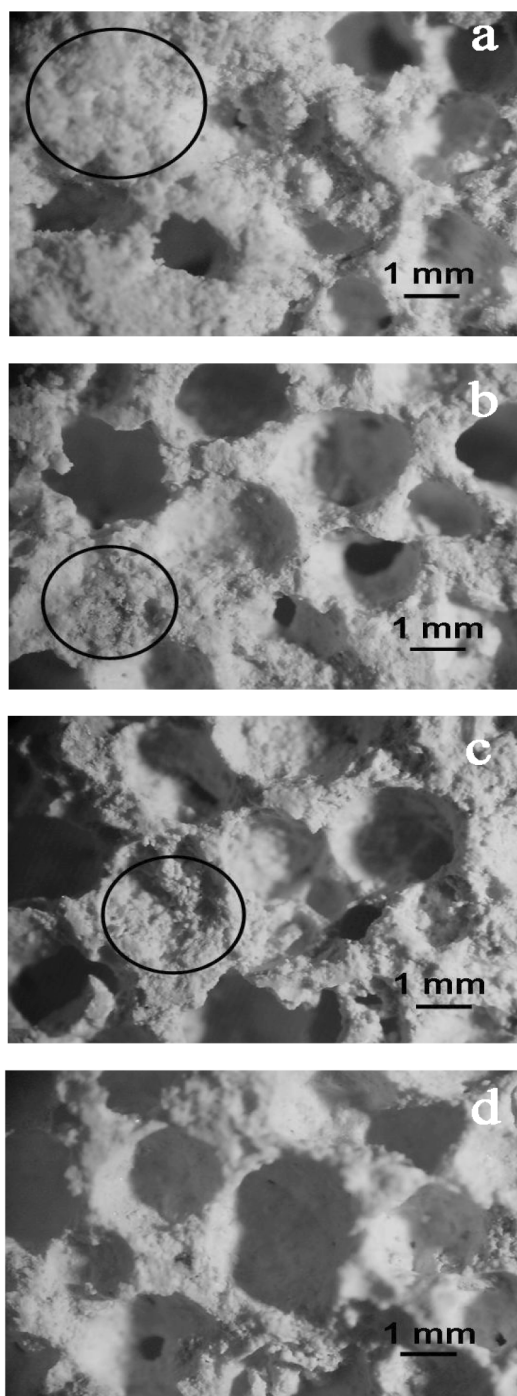


Fig. 12. Macrostructure of CAACW crumbs unprocessed (a) and processed during the neutralization (b, c, d) by the following chemicals: b – dechromator suspension of 5.00%, c – decanted solution of FeSO_4 , d – decanted solution of FeSO_4 with 0.02% addition of surfactant Ufapore TCO[®]. The area of CAACW crumb surface coated with fine particles and dust is marked by circles

Though after neutralization, the CAACW crumbs were thoroughly rinsed in distilled water, the efforts to remove particles and dust failed. Only once surfactant Ufapore TCO[®] in 0.02% of solution mass was added to the transparent FeSO_4 solution, the modification of the surface of crumbs was successful. Subsequently, the walls of crumb pores became clean (Fig. 12d).

The additional investigations showed that the dried neutralized CAACW crumbs with modified exterior surface do not stick to cat soles, do not contaminate the environment, adsorb liquid just as well as crumbs before neutralization (as showed in Fig. 9 curve 1) and are environmentally friendly, therefore, can be used for production of cat litter.

4. Conclusions

1. The practical use of CAACW will help us solve two important environmental problems: on the one hand – to recover the industrial waste, on the other – to prevent ground pollution by effused oil products.

2. Taking into account the adsorption effectiveness, the CAACW can be separated in two different fractions:

- powder (size up to 2.50 mm) for adsorption of used engine oil and other oil products with analogical values of viscosity and rate of adsorption;
- crumbs (size from 2.50 to 10.0 mm), for adsorption of oil products of lower viscosity, as well as for production of litter for cats after neutralization of CAACW crumbs by 2.00% FeSO_4 solution with added 0.02% surfactant Ufapore TCO[®].

3. Taking into consideration the equilibrium adsorption moisture of AAC, we recommend drying CAACW to residual moisture of 3.50% in all cases.

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SMULKINTŲ AUTOKLAVINIO AKYTOJO BETONO ATLIEKŲ SORBCINIŲ SAVYBIŲ TYRIMAI**M. Sinica, G. Sezemanas, D. Mikulskis, M. Kligys, V. Česnauskas****S a n t r a u k a**

Autoklavinio akytojo betono (AAC) gamybos proceso metu kietinus autoklave ir gautą masyva mechaniškai apdirbus neišvengiamai susidaro atliekos, kurios iki šiol nėra tinkamai perdirbamos. Straipsnyje nagrinėjama smulkintų AAC atliekų sorbcinė geba. Nustatyta, kad kai kurių skysčių (vandens, dyzelino, varotos mašininės alyvos) sugėrimo efektyvumas priklauso nuo skysčio klampio, kuris savo ruožtu lemia skysčio įsigėrimo gylį į sorbento bandinius. Atsižvelgiant į šį rodiklį, smulkintos AAC atliekos buvo suskirstytos į dvi frakcijas: miltelius (dydis iki 2,5 mm) ir trupinius (dydis nuo 2,5 iki 10,0 mm). Nustatyta, kad skirtingo klampio naftos produktai įgeriami AAC milteliais: dyzelinas – 0,52 g/g per 18 min, o varota mašininė alyva – 0,39 g/g per 1 h 15 min. Trupintos AAC atliekos, apdorotos 2,0 % koncentracijos FeSO₄ tirpalu ir išdžiovintos iki 3,5 % likutinio masės drėgnio, yra tinkamos naudoti kaip kačių kraikas. Praktinis trupintų AAC atliekų naudojimas leis iš karto spręsti dvi svarbias ekologines problemas: pirmuoju atveju – utilizuoti pramonines atliekas, antruoju – stabdyti grunto taršą dėl išsiliejusių naftos produktų.

Reikšminiai žodžiai: autoklavinis akytasis betonas, pramonės atliekos, sorbentai, sorbcinės savybės, kalcio hidrosilikatai, makrostruktūra, naftos produktai, kačių kraikas.

ИССЛЕДОВАНИЕ СОРБЦИОННЫХ СВОЙСТВ ИЗМЕЛЬЧЕННЫХ ОТХОДОВ АВТОКЛАВНОГО ЯЧЕИСТОГО БЕТОНА**М. Синица, Г. Сеземанас, Д. Микульскис, М. Клигис, В. Чеснаускас****Р е з ю м е**

В процессе изготовления автоклавного ячеистого бетона после твердения в автоклаве с последующей механической обработкой массива неизбежно накапливаются отходы, которые до сих пор должным образом не утилизировались. В статье представлены результаты исследования сорбционной способности измельченных отходов автоклавного ячеистого бетона. Установлено, что эффективность поглощения некоторых жидкостей (воды, дизелина, отработанного машинного масла) этими отходами зависит от вязкости жидкости, которая, в свою очередь, определяет глубину поглощения жидкости образцами сорбента. В зависимости от этого показателя отходы ячеистого бетона были разделены на две фракции: порошок (крупность частиц составляла до 2,5 мм) и крошку (крупность частиц – от 2,5 до 10 мм). Установлено, что жидкие нефтяные продукты в зависимости от их кинетической вязкости полностью насыщают порошкообразные отходы, а именно: дизелин – 0,52 г/г за 18 мин, отработанное машинное масло – 0,39 г/г за 1 ч 15 мин. Крошкообразные отходы, обработанные 2,0%-м раствором FeSO₄ и высушенные до 3,5% остаточной массовой влажности могут применяться в качестве наполнителя для кошачьих туалетов. Практическое применение измельченных отходов автоклавного ячеистого бетона позволяет одновременно решить две экологические проблемы: во-первых, утилизировать промышленные отходы, а во-вторых, предотвратить загрязнение грунта разлившимися нефтепродуктами.

Ключевые слова: автоклавный ячеистый бетон, промышленные отходы, сорбенты, сорбционные свойства, гидросиликаты кальция, макроструктура, нефтяные продукты, наполнитель для кошачьих туалетов.

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