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2

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Vashkurak U., Falyk T., Shevchuk L. The Influence of the Nature of the Gas into the Cavitation	
Destruction Organic and Biological Contanination of Wastewater from Brewing Industry	74
Shpyrka I., Nebesnyi R., Sydorchuk V., Khalameida S., Ivasiv V., Zavalii K. Catalysts	
of Aldol Condensation of Acetic Acid with Formaldehyde	76
Yakubik V., Zayats S., Havryliv R. Kinetics of Polymer Dispersion Drying	
dy the Conduction Method	
Zhyhailo M., Demchyna O., Demydova Kh., Yevchuk I. Rheological Investigation	
of Sol-Gel Systems Based on 3-Methacryl-Oxypropyl Trimethoxysilane	79
Pidhirnyi R., Hlukhaniuk A., Motrunich O., Ivashchuk O., Starchevskyv V.	
The Simulation of Cavitation Process Using the Engineering Analysis Methods	
Palianytsia L., Berezovska N., Kosiv R., Pikh Z., Kharandiuk T. Activation	
of Alcohol Yeast	
Koval I. Comparison of the Bacteria Destruction with and Without Gas Action and Cavitation	
Baran N., Melnyk Yu., Grytsenko O., Yaculchak G., Shapoyal C. Development	
of the Forming Technology of Combined Membranes Based on Hydrogel and Polycaproamide	
Nagurskyv A., Grynyshyn O., Khlibyshyn Yu., Antoshkiy D. Compounded and Raw Rubbers	
for Bitumen Modification	
Kostiv L. Marshalok G. Effect of the Reactants Molar Ratio on the Kinetics of Cycloaddition	
of 2.3-Dimethylbuta-1.3-diene to methylacrylate	
Kovalchuk T., Kostiv I. Investigation of Kinetic Regularities of Rice Drving Process	
Werner L. Jackiewicz-Zagórska A., Gac Ja, Simultaneous Filtration of Liquid and Solid Aerosols	
on Fibrous Filters	
Danvliuk O., Atamanvuk V., Bachvk M., Romanov V. Dissolution of solid	
polydisperse materials during pneumatic mixing	
Wierzba P., Krasiński A. Preparation of Highly Hydrophobic Cellulose Based Surfaces by	
Silica Particles and Fluorosiloxane Deposition	
Kovalchuk A., Pidhirnvi R., Lesiuk U., Ivashchuk O. The simulation of the heat trans	
fer equipment using methods of engineering analysis	103
Kindzera D., Atamanyuk V., Hosovskyi R., Shkromyda M. The heat transfer during	
the filtration drving of the grinded sunflower stems	
Atamanyuk V., Huzova I., Gnativ Z., Hrynkiv M., Bodnar M. Research	
of the process of regeneration of activated carbon during filtration drving	
Mariichak O., Shevchenko M., Rozantsev G., Radio S. Pr-, Nd-, and Eu-Containing Heteropoly	
Tungstates With Peacock–Weakley Anion: Synthesis From Aqueous-Acetone Media,	
FT-IR Spectroscopy, and Surface Micromorphology	109
Chobit M., Vasylvev V., Panchenko Yu. Application Of Oil And Fat Industrial Wastes	
For Modification Of The Fillers	

4th INTERNATIONAL ACADEMIC CONFERENCE "ENVIRONMENTAL PROTECTION, NATURAL RESOURCE MANAGEMENT AND TOURISM 2017"

Alper A., Ceyhun C. Kılınç, Şahin M., Gazi E. Measuring the Awareness Level	
of Local Tourists in Their Tourism and Environment Relations: A Research in Tarsus	
Dyachok V., Katysheva V. About problem of absorption of greenhouse gas	
by chlorophyilsynthesizing microalgae in the presence of sulfur dioxide	
Pryshliak N. Public Policy and Biofuels: Energy, Environment and Food Trilemma	120
Soloviy Kh., Malovanyy M. Conditions for cyanobacteria biomass development and selection	
for further processing	
Kholiavka L., Olishevs'ka O. Peculiarities of ecological labeling of goods in Ukraine	
Kholiavka L., Yahodynets O. Problems and prospects for export development	
of domestic organic production for the European Union Market	126
Martynyuk V., Dzvonyk V. Macroeconomic factors of commercial entrepreneurship	
development in Ukraine	
Dzhumelia E., Pohrebennyk V. Environmental Impact of Mining and Chemical Industry	
Bets M., Magdych M. Development of the Production of Ecological Goods in Ukraine	
and Their Labeling and Compliance With Standards	
Bets M., Basiuk N. Contents of the socio-environmental responsibility in electronic equipment	
and machinery trade	

16 INTERNATIONAL YOUTH SCIENCE FORUM "LITTERIS ET ARTIBUS", 23–25 NOVEMBER 2017, LVIV, UKRAINE

Pr-, Nd-, and Eu-Containing Heteropoly Tungstates With Peacock–Weakley Anion: Synthesis From Aqueous-Acetone Media, FT-IR Spectroscopy, and Surface Micromorphology

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Abstract – The conditions for the synthesis of pure inorganic sodium heteropoly decatungstometalates (III) – $Na_9[Pr(W_5O_{18})_2]\cdot34.25H_2O$, $Na_9[Nd(W_5O_{18})_2]\cdot34H_2O$, and $Na_9[Eu(W_5O_{18})_2]\cdot34H_2O$, from the aqueous solution of sodium tungstate acidified to Z=0.80 with a ratio v(Ln):v(W)=1:10 and with acetone admixture were established. Isolated salts were analyzed using Elemental Analysis, FT-IR spectroscopy, and Scanning Electron Microscopy

Keywords – Praseodymium, Neodymium, Europium, polyoxotungstate, heteropoly anion, Peacock-Weakley structure.

I. Introduction

The precis presents the results of synthesis of heteropoly compound with Peacock-Weakley [1] type anion $Na_9[Ln(W_5O_{18})_2]nH_2O$, which was carried out by the self-assembly from WO_4^{2-} and Ln^{3+} (Ln=Pr, Nd, Eu) in an acidify aqueous solutions; it also studies its structures by FT-IR spectroscopy, and surface micromorphologies by Scanning Electron Microscopy.

II. Experimental Part

In the study, Na₂WO₄·2H₂O, HNO₃, Pr(NO₃)₃·6H₂O, Nd(NO₃)₃·6H₂O, Eu₂O₃ (all are ACS reagent grade) aqueous solutions were used. The Eu(NO₃)₃ solution was prepared by dissolving Eu₂O₃ in HNO₃. Excess amount of HNO₃ was removed by two-fold evaporation until wet residue was formed, which then was dissolved in distilled water.

The synthesis of Na₉[Ln(W_5O_{18})₂]·nH₂O was carried out as following. Sodium tungstate solution was added to distilled water, and then HNO₃ solution was added dropwise with vigorous stirring. After that Ln(NO₃)₃ solution was added dropwise very slowly with vigorous stirring. It bears mentioning that each next drop of Ln(NO₃)₃ was added only after the disappearance of opalescence from the previous drop. The volume of the final aqueous solution amounted to 100 mL. Adding of reactants corresponds to the stoichiometry of the reaction, during which heteropoly decatungstolanthanidate(III) anions are formed [2]:

$$Ln^{3+} + 10WO_4^{2-} + 8H^+ \leftrightarrows [Ln(W_5O_{18})_2]^{9-} + 4H_2O,$$

 $Z = \nu(H^+)/\nu(WO_4^{2-}) = 0.80.$

In order to isolate salt with the resulting anion as a crystalline precipitate, 100 mL of acetone was added to the solution. Then, the resulting product was sealed and stored for 3 days at 6^{0} C that led to the formation of needle-like (or plate in case of a salt with Europium) crystalline precipitate.

Instrumental methods of analysis.

FT-IR spectroscopy. FT-IR spectroscopy was used to identify anion in the synthesized salt. FT-IR spectra of the air-dry samples of salts were recorded on FTIR Spectrum BXII (Perkin-Elmer), within the wavenumber range of $400-4000 \text{ cm}^{-1}$. For this, a weighed amount of salts (0.0030 g) were triturated with crystalline KBr (0.6000 g) and compressed into a thin disk.

Microscopic analysis. Microscopic study was conducted by scanning electron microscopy (SEM) with microscope JSM–6490LV (JEOL). Air-dry samples deposited on a conductive graphite scotch tape were studied in backscattered electron (BEC) mode used for the elemental analysis of phases being the parts of the sample, and in secondary electron (SEI) mode used to study the surface of the resulting salts. Elemental analysis during the microscopic studies were performed with energy-dispersive X-ray spectrometer INCA PentaFETx3 (OXFORD Instruments).

III. Results and their Discussion

Acidity Z = 0.80 in the presence of stoichiometric amounts of reactive ions corresponds to the formation of heteropoly decatungstometalate(III) anions:

$$Ln^{3+} + 10WO_4^{2-} + 8H^+ \Leftrightarrow [Ln(W_5O_{18})_2]^{9-} + 4H_2O$$

(Ln – Yttrium or lanthanides).

To isolate such particles with Pr(III), Nd(III), and Eu(III) ions-heteroatoms, sodium tungstate solutions $(C_W=0.1 \text{ mol/L})$ acidified to Z = 0.80 were used, to which $Ln(NO_3)_3$ solutions were added with vigorous stirring. After mixing of the components in a stoichiometric ratio of X:W=1:10, acetone were added to the systems (up to 50 vol. %) and formation of needle-like (or plate in case of a salt with Europium) crystalline precipitates were observed. Products yield were ~90%; loss amounting to ~10% were lost likely caused by the solubility of salt when washing the precipitate with water-acetone mixture (1:1) during its separation from the mother liquor. According to the results of the chemical analysis and EDX the isolated precipitates were assigned formulas $Na_9[Pr(W_5O_{18})_2] \cdot 34.25H_2O_1$ $Na_{9}[Nd(W_{5}O_{18})_{2}]\cdot 34H_{2}O_{18}$ and $Na_9[Eu(W_5O_{18})_2]$ ·34H₂O.

Nature of stretch and deformation vibrations in the tungsten-oxygen framework within FTIR spectra of air-dry samples of salts (Fig. 1) also indicates to the presence of Peacock-Weakley heteropoly anion of 10th row in them.



Fig. 1. FT-IR spectra of cristalline salts with $[Ln(W_5O_{18})_2]^{9-}$ anion.

In this anion, two lacunar tetradentate pentatungstateanions $[W_5O_{18}]^{6-}$ are coordinated to Ln-heteroatom, thus forming a coordination polyhedron in the shape of a square antiprism.

Microscopic analysis showed that the surface of grains in the isolated salts has fuzzy blurred edges. The size of the grains for the triturated in agate mortar sample of Na₉[Ln(W₅O₁₈)₂]·34H₂O is within the range of 200– 400 nm (Fig. 2).

Uniform surface contrast in backscattered electron (BEC) mode points to single-phaseness of the isolated salt (Fig. 3).

On the micrographs of the salt powder in characteristic X-ray emission there are no regions with different surface morphology, and there is an even distribution of Ln (Pr or Nd or Eu), Na, W, O, without segregations and eliquations. These clearly indicate the formation of single-phase samples.



Fig. 2. SEM image of Na₉[Eu(W₅O₁₈)₂]·34H₂O powder surface.



Fig. 3. SEM-image of $Na_9[Eu(W_5O_{18})_2]$ ·34H₂O powder surface in backscattered electron mode (× 50 times)

Conclusion

The conditions for the synthesis of a new pure inorganic heteropoly tungstates $Na_9[Ln(W_5O_{18})_2]nH_2O$ (Ln = Pr (n=34.25), Nd (n=34), Eu (n=34)) from the aqueous solution, acidified to $Z=v(H^+)/v(WO_4^{2^-})=0.80$ with acetone adding, were determined. FT-IR spectroscopy was used to show that the anion within the synthesized salt has a Peacock-Weakley structure. Scanning electron microscopy confirmed the single-phaseness of the synthesized salts.

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References

- R. D. Peacock, T. J. R. Weakley, "Heteropolytungstate Complexes of the Lanthanide Elements. Part I. Preparation and Reactions", J. Chem. Soc. A., pp.1836-1839, 1971.
- [2] O. Yu. Mariichak, E. S. Ivantsova, G. M. Rozantsev, et al. "Thulium-Containing Heteropoly Tungstate With Peacock–Weakley Anion: Synthesis, Properties, And Surface Micromorphology", Vopr. Khimii Khim. Tekhnologii, № 3, pp.38-44, 2015.

Martyniuk V. 331 Martynyuk V. 128 Masonkov O. 281 Masyuk A. 70 Matiko F., 192 Matviy S. 333 Mazur A. 335 Medvedeva A. 194 Medvid' R. 184 Melnyk O. 337 Melnyk R. 42 Melnyk S. 64 Melnyk Yu. 62, 87 Mitina N. 50 Mnykh R. 26 Moiseenko D. 339 Moravskyi V. 30 Motrunich O. 81 Moviaka O. 206 Mulder T. 442 Mushyn I. 339 Muzychak A. 184 Muzychak A. 180 Muzychuk I. 335 Mykich Kh. 418 Mysak S. 190 Nadashkevych Z. 50 Nagorniak M. 52 Nagurskyy A. 89 Nahide Gulsah D. 32 Nakonechnyi I. 168 Nebesnvi R. 76 Noordhoek J. H. 442 Novikov V. 32 Novitskyy Yu. 250, 260 **Obushak M. 56** Odnorih Z. 158 Oleksa V. 52 Olishevs'ka O. 124 **Opeida Io. 58 Orobchuk O. 68** Ortvnska N. 454 Ouassim T. 226 Overchenko O. 154 Ozyurek M. 32 Paiuk O. 50 Palianytsia L. 83 Panas N. 387 Panchenko Yu. 111 Paraschak O. 70 Pasternak O. 341 Peresunko A. 142 Pidhirnyi R. 81, 103 Pidsadiuk M. 68 Pikh Z. 83

Pishatchin M. 389 Pivtorak Yu. 240 Plesak S. 283 Pliushko O. 58 Pohrebennyk V. 130, 150 Pokhodylo N. 56 Politylo R. 150 Popadynets N. 341 Popovych O. 146 Postranskyy T. 269 Pryhoda M. 283 Prykhodchenko D., 152 Prykhodko V. 267 Pryshliak N. 120 Prysiazhnyi Yu. 60 Pyshyev S. 60, 66 Radeiko R. 456 **Radio S. 109** Romaka V. 262 Romaka L. 262 Roman V. 192 Romaniuk O. 186 Romaniv V. 178 Romanov V. 99 Rozantsev G. 109 Rusanovska O. 343 Rybchak Z. 414 Rykavets Z. 262 Rymar T. 188 Ryzhak D. 262 Rzheuskiy A. 412 Sabadash V. 148 Sachuk O. 46 Sadova U. 362 Sagan O. 60 Şahin M. 114, 345 Saiuk D. 24 Sakar M. G. 422, 425 Salamaha S. 392 Sanzhak O. 48 Savulyak V. 265 Semenchuk V. 206 Serdiuk V. 42 Sereda A. 144 Shakhovska Kh. 394 Shapar R. 44 Shapoval C. 87 Shapoval P. 36, 54 Shapovalova K. 383 Shenbor V. 248, 254 Shenbor Yu. 254 Shepida M. 40 Shevchenko M. 109 Shevchuk L. 74 Shevchuk O. 24, 42