ICNTC E-CONFERENCE

INTERNATIONAL CONFERENCE ON NEW TRENDS IN CHEMISTRY

7th INTERNATIONAL CONFERENCE ON NEW TRENDS IN CHEMISTRY

25 - 26 SEPTEMBER 2021

7th ICNTC BOOK OF ABSTRACTS

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http://www.icntcconference.com/

ICNTC E- Conference 2021

7th International Conference on New Trends in Chemistry

Published by the ICNTC Secretariat
Editor:
Assoc. Prof. Dr. Dolunay ŞAKAR DAŞDAN

ICNTC Secretariat
Büyükdere Cad. Ecza sok. Pol Center 4/1 Levent-İstanbul
E-mail: icntcconference@gmail.com
http://www.icntcconference.com

Conference organised in collaboration with Monre Academy

ISBN: 978-605-67476-7-0

POWDER MIXTURES OF β--TRICALCIUM PHOSPHATE AND POTASSIUM HYDROSULFATE HOMOGENIZED UNDER MECHANICAL ACTIVATION FOR CERAMICS PREPARATION

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Abstract

Powder mixtures of β-tricalcium phosphate β-$Ca_3(PO_4)_2$ and potassium hydrogen sulfate $KHSO_4$ homogenized under mechanical activation in acetone medium in planetary mill were used for producing of ceramics in K_2O-CaO-SO_3-P_2O_5 system. Powder mixtures were prepared at molar ratios of $Ca_3(PO_4)_2$/$KHSO_4$ established as 7/2, 4/2 and 1/2. The following formal reactions were used for calculation of quantities of starting components to create opportunity of preparation of ceramic composite materials containing calcium sulfate anhydrate $CaSO_4$ and phases of double calcium potassium phosphates such as potassium-substituted tricalcium phosphate $KCa_{10}(PO_4)_7$ and potassium rhenanite $KCaPO_4$ (labeling is given in brackets):

$7Ca_3(PO_4)_2 + 2KHSO_4 \rightarrow CaSO_4 + 2KCa_{10}(PO_4)_7 + SO_3 + H_2O$ («7/2»)

$4Ca_3(PO_4)_2 + 2KHSO_4 \rightarrow CaSO_4 + KCa_{10}(PO_4)_7 + KCaPO_4 + SO_3 + H_2O$ («4/2»)

$Ca_3(PO_4)_2 + 2KHSO_4 \rightarrow CaSO_4 + 2KCaPO_4 + SO_3 + H_2O$ («1/2»)

According to XRD analysis data β-tricalcium phosphate β-$Ca_3(PO_4)_2$ was the main phase in all powder mixtures after treatment in planetary mill in acetone media. Only powder mixture «1/2» has slight quantities of additional phases. $K_8H_9(SO_4)_7PO_4$ and $K_4H_5(SO_4)_3PO_4$ were found additionally to β-tricalcium phosphate β-$Ca_3(PO_4)_2$ in powder mixture «1/2». Presumably phases of syngenite $K_2Ca(SO_4)_2 \cdot H_2O$ and/or gorgeyite $K_2Ca_5(SO_4)_6$ H_2O presented in powder mixtures in quasi-amorphous form after treatment in planetary mill.

Compacted ($P_{specific}$=100MPa) powder pre-ceramic items based on prepared mixtures were fired at temperature range of 700-900°C for producing ceramic samples. It was found that phase composition of ceramic samples considerably depends on composition of starting powder mixtures. According XRD analysis after firing at 800°C phase composition of ceramic samples «7/2» and «4/2» contained potassium calcium phosphate $Ca_{10}K(PO_4)_7$, β-calcium pyrophosphate β-$Ca_2P_2O_7$ and calciolangbeinite $K_2Ca_2(SO_4)_3$. Phase composition of ceramic samples «1/2» contained calciolangbeinite $K_2Ca_2(SO_4)_3$, β-calcium pyrophosphate β-$Ca_2P_2O_7$ and potassium sulfate K_2SO_4. Up to our knowledge all phases of prepared ceramic samples are biocompatible. It should be noted that potassium sulfate K_2SO_4 presented in ceramics «1/2» is water soluble salt. So additional investigations are required for creation of ceramics in the K_2O-CaO-SO_3-P_2O_5 system for different uses including biomedical purposes.

Acknowledgements: The financial support of RFBR project # 20-03-00550.
Key Words: *calciolangbeinite; potassium calcium phosphate; potassium sulfate; calcium pyrophosphate; ceramics*