POTENTIALLY HARMFUL ELEMENTS IN BREAKAGES OF GLAZED TILES FROM THREE SITES IN LITHUANIA

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Introduction

Anthropogenic anomalies of heavy metals and (or) other potentially harmful elements (PHE) are often found in soil of historic habitable areas (Mapping…, 2011). The remnants of disintegration and decomposition of glaze cover which was intended to protect the buildings and their interior from ambient factors as well as for decoration comprise one of the pathways of PHE to soil. Relatively higher PHE contents in soil identify the places of their findings. Due to aggressive acidic impact and variable ambient temperature, the outwash of PHE with rain to surrounding environment or migration with dust takes place. Therefore the information about PHE contents in glaze of different colour is useful for identification and characterisation of the reasons of such anomalies and their probable extent.

Materials and methods

The breakages of more than 50 glazed tiles were sampled from the remnants of the furnaces of restored Palace of the Grand Dukes of Lithuania (the 16th century) and Biržai castle (the second half of the 17th century). They were also collected during excavations of the Castle of Klaipėda (the first half of the 16th century) and the old residential quarters of this city (from the end of the 15th century until the 20th century). There were different colours of glaze: sky blue, white, black, blue, turquoise, green, yellow, brown, purple and colourless (transparent). The samples were analysed for real total contents of Ag, Al, As, Ba, Br, Ca, Cd, Co, Cr, Cu, Ga, Hg, Fe, K, Mg, Mn, Mo, Na, Nb, Ni, Pb, Rb, S, Si, Sn, Sr, Th, Ti, Tl, U, V, Y, Zn, Zr and W by energy dispersive x-ray fluorescence and atomic emission spectrometry. Aiming to estimate the potential of glazed tiles to contaminate soil, the contents of PHE were compared with maximum permissible concentrations applied for soil in Lithuania (Derivation…, 2007) and pollution indices (PI) were calculated.

Results

Some possibilities of tile glaze from Biržai castle furnace to contaminate soil were discussed earlier (Taraškevičius et al., 2007). Blue tiles are distinguished by the highest potential to contaminate soil. The sequence of PI>100 includes Co>Pb>Sn>Sb, of PI>10 includes Cu>Ni>Mo. Blue glaze is followed by black glaze (PI>100: Pb>Cu>Sb, PI>10: Sn>Mn), the latter by purple (PI>100: Sn>Pb, PI>10: Sb>Mn>Cu), brown (PI>100: Pb, PI>10: Sn>Sb>Mn), green (PI>100: Pb>Cu, PI>10: Sb), turquoise (PI>100: Sn>Pb>Cu,

PI>10: Sb), sky blue (PI>100: Sn>Pb>Sb, PI>10: Cu), colourless (transparent) (PI>100: Pb, PI>10: Sb>Sn), yellow (PI>100: Sb>Pb>Sn) and white glaze (PI>100: Sn>Pb, PI>10: Sb). Though the contents of the main chemical elements determining the colours dominate in findings of different places, glaze chemical composition in each finding is specific. As a result, the dominating elements are accompanied by different contents of other PHE, e.g. Ag, Zn, Cd, Bi, as well as of other chemical elements.

Conclusion

It has been determined that actually the contents of all potentially harmful elements exceeding maximum permissible concentrations in soil can be found in glaze. However, each colour is predetermined by different proportions of only several specific chemical elements, usually Pb, Sn, Sb, Cu, Co, Mn, Ni. High contents of any other chemical elements are also possible; they depend on the origin, glaze production technology and purity of raw material used.

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