



Glass microspheres in the urban environment – a key signal for the Anthropocene

Zdzisław Migaszewski and Agnieszka Gałuszka

Jan Kochanowski University, Institute of Chemistry, Geochemistry and the Environment Div., Kielce, Poland
(zmig@ujk.edu.pl)

The glass microspheres (glass microbeads) have been utilized as a component in production of road signs, including reflective traffic paints and various road markings, since 1914. The glass microspheres are mineral-like man-made phases manufactured in high-temperature fluidized bed technique from soda-lime borosilicate, aluminous-borosilicate glasses or perlite. They occur in the form of solid, or hollow glass microspheres (microbubbles or microballoons) varying from 0.001 to 1 mm across. Under stereoscopic and petrographic microscopes, the glass microspheres form single particles of different sizes and shapes or composite aggregates composed of a bigger spherule with a ring of microspherules. In transmitted or reflected and crossed-polarized light, they are optically isotropic as opposed to co-occurring anisotropic quartz grains. The solid glass microspheres may resemble microtektites showing the same appearance, but the former can be discerned by distinct enrichments in Pb, As and Sb oxides being the common additives in production of microbeads.

Degradation of road signs causes the release of glass microspheres to the surrounding environment. They are washed away by rainfall or snowmelt and carried into the storm water drainage systems. The smallest spherules can also be blown by wind and laid down at a different distance from roads. Subsequently, the microbeads are transported and deposited in stream and river sediments. Due to their high buoyancy, they can be redeposited during elevated river water levels.

The pioneer study conducted by Gałuszka and Migaszewski (2018) in the city of Kielce (south-central Poland) have shown that the glass microspheres occur in large quantities in the road dust (800-2700 microspheres/kg). It is interesting to note that hollow glass microspheres are the only form that predominates in here. This unique appearance, optical isotropy and a lack of tiny mineral inclusions facilitate discrimination of the glass microspheres from quartz grains. The microbeads were found in the sediments of the Silnica River that flows through the city of Kielce. Their highest content was observed near discharges of street stormwater into the river, but the microspheres were also traced in the sediments at a distance of several hundred meters away from each micropollutant source. The significance of these studies has recently been underscored by Dr. Carl Sayer of the University College London who found particles very similar to the glass microspheres in the otter spraint (Prof. Neil Rose, pers. com.). This shows that these microbeads could enter the food chain and can be very widely distributed in the environment.

The glass microspheres seem to be one of the best signatures of the Anthropocene. They possess some features of the best indicator, e.g. low density (especially hollow glass microspheres), high thermal stability and good resistance to weathering. These properties indicate that the glass microspheres have a strong preservation potential in future strata, which may be evidenced by microtektites found in the Precambrian (3.4-2.5 Ga) beds of South Africa and Australia. Needless to say, the glass microspheres will be more widespread in the environment due to the rapid growth of road network throughout the world and an increased demand for this material.