SUMMARY

The aim of this research was to study effects of environmental conditions on mechanical and optical properties of "smart road" polymer composite pavement. The main objective of study was to discover best tempered glass particle-reinforced thermoset composite material to be used as encapsulation material for "smart road" pavement, which could withstand environmental conditions in Estonia.

To pursue this aim, tempered glass particle-reinforced thermoset composite materials (TCMs) were developed using thermoset resins and tempered glass particles (TGP) as a reinforcement filler. Six different types of TCMs' samples were conditioned through freeze/thaw cycles, heat aging, UV aging and water absorption to simulate the exposure of weather conditions of Estonia. To evaluate the effects of weathering on TCMs properties, mechanical and optical tests were conducted.

The results of present study demonstrate that three out of six TCMs may be used as an encapsulation material for "smart road" pavement, as these composite materials have withstood freeze/thaw cycles, heat aging, UV aging and water absorption without dramatical loosing of their mechanical and optical properties which are crucial for encapsulation material. Developed during current study TCMs are more efficient compared to all of previously used encapsulants, which have somehow degraded and encountered with durability issues and power efficiency reduction due to transparency deprivation caused by environmental factors.

In addition, this study has revealed a new horizon of sustainability of glass industry through discovering new way to re-use tempered glass in "smart road" polymer composite pavements without melting or re-processing it. Since decades, glass industry is struggling with tempered glass recycling after disposed from automobile and construction industry. It melts at higher temperature and this is what makes it difficult to recycle, as un-melted glass agglomerates or blobs leads to poor quality of recycled glass products. In case of "smart road" polymer composite pavements, it is simply milled to required mesh size and then incorporated to the matrix resin without use of any complex processing and energy consumption.

In future, it is recommended that different mesh size tempered glass particles of regular shape should be used with thermoset resins which need thermal curing, as these matrix resins will develop strong adhesion with glass particles and will result in immense increment

in mechanical properties which are of prime importance to withstand cyclic loads generated by pedestrian and automobiles run over “smart road” polymer composite pavements installed in roads and sidewalk etc.