Utilisation of waste tires for pavement foundation

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PROBLEM. The standard recycling market of waste tires (leading to production of "clean" granulate after the costly metal cord removal) is unstable, which lead to large landfilling area (Fig. 1.) One of the recycling option is to use it for pavement foundation construction (without cord removal).

INTRODUCTION. Current techniques for pavement foundation face the following problems: (1) use of energy intensive materials, like cement and its additives, which generate much waste during their production, (2) limited water infiltration through the soil, (3) cement hardening under the pavement, (4) fragility against vibration of surrounding infrastructure (road traffic, etc.), (5) long-lasting, loud and unesthetic assembly, (6) pavement damages (Fig. 1).

Fig. 1. Waste tires landfill and pavement damage due to unstable subsurface

THE PROPOSED SOLUTION.

The invention relates to both a **waste-tires based product** (2) and a **method** of processing it by means of grinding and chemical or thermal bonding into rubber patches (*PLASTRY Kuligowskiego®*) serving as foundation for paving slabs, smooth rubber layers for playgrounds and urban surfaces as well as stabilizing the soil against local subsidence.

The above concept has the following advantages related to:

CIRCULAR ECONOMY: utilization of raw tire waste at the very early stage of their value chain: in the form of scraps and shavings, together with metal cord, that is normally costly removed for further processing towards the granules.

ADAPTATION TO CLIMATE CHANGE: rainwater infiltration (currently only 15% of water infiltrates through paved urban surfaces) through porous structure of the *PLASTRY Kuligowskiego®*. The PLASTER is highly permeable so probably it does not need any additional perforation.

Fig. 2. Products from waste tires (left) and PLASTER Kuligowskiego® (right)

LIMITATION OF CEMENT CONSUMPTION: Elimination of cement-sand bedding under paved surfaces.

Additionally the following effects should be underlined: (1) IMPROVING ACOUSTICS and ELIMINATION OF VIBRATIONS for buildings and other constructions, (2) EASY TO ASSEMBLE AND DISASSEMBLE in the case of emergent earthworks, (3) HIGH AESTHETICS OF THE PLASTER, (5) NO DAMAGE OF THE SURFACE resulting from washing out or insects and small animals (e.g. ants, moles).

This proposal is in line with the objectives of the **Circular Economy Action Plan**, which focuses on the sectors, where the potential for improvement is high, like plastics, textiles, construction and buildings. The proposal is also coherent with the **EU Green Deal**, namely it supports reduction of net greenhouse gasses emissions by 2050 and helps decoupling the economic growth from resource use, by recycling waste tires into products for urban pavements, smooth and elastic playgrounds, etc. This action is also in line with the **Waste Framework Directive**. The Directive requires that waste will be managed without endangering human health or harming the environment, without risk to water, air, soil, plants or animals.

READINESS. The Technology Readiness Level (TRL) of this technology is still rather low ca. 4-5; the mechanical tests are finished, but some activities need to be continued related to the PLASTER's water permeability, mechanical strength, fatigue parameters load-bearing capacity, deformability and economy.

ISWM Framework Positioning of the Case Story

Stakeholders: Citizens, Local Authorities

Waste System Elements: Waste treatment, Recycling, Reuse

Aspects: Technical, Environmental, Financial, Socio-cultural, Institutional, Policy/legal

The technology is closely related to the Integrated Solid Waste Management (ISWM) framework. As the intended use is construction of urban paved areas, national and local authorities are responsible for decision-making but citizens (pedestrians and some drivers) are the final users. The covered Waste System Elements are: **tire waste treatment** via crushing, pressing, forming and chemical bonding, then **recycling** as patches or slices (PLASTERs) for pavements subsurface. "Financial/ Economic" benefits are expected due to savings in avoiding costly cord removal and also due to avoidance of "rainwater tax" for the property owner, due to better water permeability of the paved area after application of PLASTERs. There is a number of environmental benefits, i.e. water permeability, waste tires recycling, prevention of cement production, reduced noise nuisance at construction stage, low or no subsidence nor collapsing of the paved areas, whereas "Sociocultural", "Institutional", "Policy/ legal/ political" factors need to be considered if scaled out and applied in real scale.

Lessons learned:

- Waste tires could be turned into a new valuable product omitting the costly cord removal;
- The technology for forming the *PLASTRY Kuligowskiego®*) is available without a need for any serious adjustments;
- Some technical problems need to be solved such as material uniformity, water permeability, mechanical and safety aspects;
- The economic considerations should address the issues of competitiveness in relation to classical cement-sand bedding.

The originator of the idea and owner of the PLASTRY Kuligowskiego® patent application P.438272 is Michał Kuligowski. The investigations have been done by Beton Expert Przemysław Kamiński, co-coordination and Cost-benefit analysis by The Szewalski Institute of Fluid-Flow Machinery Polish Academy of Sciences.

Acknowledgment :

This research was supported by the WasteMan project co-funded by the European Union (European Regional Development Fund & European Neighborhood Instrument) under the the Interreg South Baltic Programme 2014-2020 framework and by the program of the Minister of Science and Higher Education entitled "PMW" in 2021 - 2022; contract no. 5172/SBP 2014-2020/2021/2