PARTICULARITIES OF TRAM WHEELS WEAR IN FOUR SEASONS CLIMATE: FOCUS ON MECHANISM IDENTIFICATION & SURFACE TOPOGRAPHY

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ABSTRACT

Starting from the 80[s] of the XX century, one can see the renaissance of trams as the main means of urban transport in large cities of Europe and North America. The current return to this public transport solution is caused by many social and economic factors, including: designing routes independent of a car traffic (fast moving avoiding traffic jams), an ergonomic and comfortable construction (e.g. low-floor vehicles), beneficial an economic and pollution aspect.

Increasing development of tram networks and increasing number of used urban rail vehicles generates the need to search for solutions that maximize their durability and reliability. Taking into consideration the tribological point of view particularly relationship between motion and friction, the wheel/rail contact of tram is particularly important. Therefore, the purpose of this part of study was the identification of wheels tires wear mechanism as a starting point to increase their wear resistance in the future (in continental climate - Dfb according to Köppen classification). The analysed objects were wheels tires dismantled from three types of trams: Siemens Combino, Moderus Beta and Solaris Tramino. All mentioned trams are operating in Poznan Public Transport Company (Poland, 18 lines of 147 km). Analysed tires were from the first bogie – the driven bogie of the tram (hypothetically highest wear due to highest load).

The wheel-rail contact durability is related to the synergistic effect of various mechanisms of wear due to friction, rolling and fatigue. For typical rail transport the length of straight sections of rails is definitely higher than arcs and the acceleration/breaking frequency is relatively low. In this case a fatigue crack initiation and propagation typically dominates (RFC – rolling fatigue crack). RFC of wheel and rail surfaces can be twofold and evolve as: spalling or shelling. The effect of both mechanisms is the flaky surface failures, but their course and activating factors are different. Tram traffic is characterised by frequent starting and braking of vehicles as well as the need to overcome narrow curves and crossovers. As a consequence tram wheels are exposed to slip which can cause their local heating to a temperature even above 300 °C for a longer period time. A less frequent but more dangerous form of RFC – shelling can occur on tires surfaces (Fig. 1).

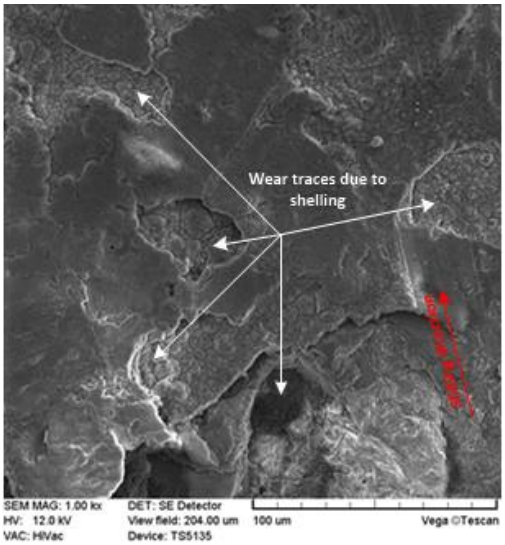

Fig. 1. Selected SEM pictures of worn surface of tram wheels tire at four season's continental Dfb climate.

It is some paradox that the wear's studies of wheels and tram rails in a slight way relate to the geometric aspect of their surfaces. Therefore, the analysis of the surface topography of tram wheels tires in the context of identified wear processes was additionally carried out. On this basis, specific roughness parameters were selected that may be helpful in servicing tram wheels tires and early detection of developing wear process.