Doctorant: Stepan Bobrovnikov

Sujet: "Analysis of the mechanisms relating to tire/road wear in relation to the emissions of fine particles"

These resume:

Maintaining a high level of skid resistance to ensure the safety of road users results in progressive wear of the tires and the road surface. The consequences of this wear are generally described in terms of changes in the texture of the road surface or the coefficient of friction. However, wear also generates particles at the tire-road interface. These particles, along with those from brake pads and discs, form the main source of so-called non-exhaust particles (NEPs). The NEPs emitted can have negative impacts on the natural environment and people: they can be deposited on the ground and permeate both terrestrial and aquatic ecosystems located near roads; they can also disperse in the air and have an impact on human health, especially in urban areas where they constitute the major pollutant. There are several publications in the literature relating to the collection of NEPs emitted as well as their physicochemical characterization (shape, size distribution, chemical composition). However, knowledge of the dynamics of particle emissions at the tire-road interface, the weight of NEPs in the "cocktail" of particles emitted, as well as on the tribological mechanisms that govern their production remain fragmentary. This knowledge is useful for multiple actors involved in road transport, in particular tire manufacturers and road companies.

This thesis project aims to study the influence of tire-road contact on the associated tire-road wear particles (TRWP) emissions. The thesis lies at the crossroads between the tribological analysis of wear mechanisms and the study of the mechanisms of TRWP emissions. The research proposed as part of the thesis will be carried out mainly in the laboratory. The results obtained in the laboratory will be validated by measurements carried out on the fatigue carousel and test track of the campus of Gustave Eiffel University in Nantes. The laboratory approach aims to characterize the "3rd body" formed at the tire-road interface. The concept of 3rd body, widely used in tribology, makes it possible to consider the materials released by the tire and the roadway and the evolution of their composition.

Understanding the TRWP circulation process at the tire-road interface is therefore at the heart of this thesis. The experiments will be conducted using a platform to perform tribological tests, in particular a “pin on disc” device. This device simulates the friction between an element of the tire tread and a road surface. It makes it possible to control the contact conditions (loads, speeds, etc.) and to test different variables such as the texture of the road surface or the tire rubber. The device will be adapted to the framework of the thesis by isolating it from external sources of contamination by encapsulation. This will allow the collection and then characterization of relatively pure samples of PHE associated with various configurations of tire-road contact. A fine characterization of the collected PHEs will be carried out in relation to the surface condition of the pin and the disc. The information obtained will relate to the shape, particle size distribution, density and chemical composition of the NEPs. They will be used in an attempt to establish a link between the wear and emission mechanisms. In addition, "external" PHEs - collected from the road, the tire or the brake pads - will be injected at the pin/disc interface. The objective is to understand how these particles take part in the mechanisms of wear and, therefore, their integration into the 3rd body as well as their re-emission.