**Environmental Impacts of Real Gaseous Pollutant Emissions of Agricultural Tractors**

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**Abstract.** The gaseous pollutants produced by the internal combustion engines fitted on vehicles powered with fossil fuels are considered one of the main sources causing the global warming and consequently the climate change. The main pollutants found in gaseous emission are carbon monoxide (CO), unburned hydrocarbon (HC), nitrogen monoxide and dioxide (NOx) and particulate matter (PM). In this scenario, the agricultural self-propelled machinery, in particular tractors, are believed to have a significant role, due to the generalized fitting of diesel engines, producing important amounts especially of NOx and PM.

From 1996, the EPA (Environmental Protection Agency) in USA and the European Commission issued roughly at the same time parallel standards containing a sort of road map for the massive reduction of these gaseous pollutants. The Standards were based on steps (respectively named TIER and Stage followed by a roman numeral suffix) referred to the time, defining progressively stringent emission limits relevant NOx and PM for diesel engines, in terms of g/kWh, classified in some engine power classes. The compulsory application of these limits engaged at the highest level the engine manufacturers for reducing the emissions amount: just to give and idea about the effort made, passing from Stage I to Stage V the limits of the pollutant decreased by 98%. Nevertheless, the compliance of an engine to a given step is referred to specific homologation tests. At present, no subsequent tests are provided to check the conformity of the engine along its service life. Consequently, there is no assurance that the engine is respecting the emission limits provided by its homologation step, especially in case it is heavily used and is not submitted to a diligent periodical maintenance. To ascertain the real pollutant gaseous emissions of used tractors, some models equipped with engines respecting different Stage/Tier levels were tested, using a dedicated instrumentation chain, by measuring in detail the PM and NOx emissions, in comparison with an old tractor model, which engine is out of the standard application period. Moreover, the pollutant gaseous emissions were evaluated applying the Life Cycle Assessment tool, to assess environmental impacts associated with the flora and/or fauna, such as climate change, destruction of the ozone layer, toxicity, acidification, etc.