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Development of a test methodology that evaluates the efficiency of an idle-stop device for agricultural tractor

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Idling is a vehicle condition in which the engine is running at the minimum rotational speed without accomplishing any useful work besides the generation of energy required to keep it rotating. Agricultural tractors may idle from 10 to 43% of their entire operating time and this inoperative time has to be minimized because it is deleterious for the environment, public health, fuel economy and engine life span. The idling time could be reduced adopting anti-idling devices such as the idling-stop that is very popular on modern cars, however these devices are not currently present on tractor.

Since the engine restart requires an energy surplus from the battery to run the starter motor, idling-stop devices are not efficient for very short idling periods. The aim of this study is to develop a test methodology able to predict the minimum idling time over that an idling-stop device turns to be energy efficient. Tests were conducted performing repeated engine switching on and off with different time lapses on a tractor with a maximum engine power of 194 kW. The fuel consumption was evaluated fuelling the tractor engine through a tank positioned on a precision scale. The power contribution delivered by the battery was evaluated with electrical current and voltage sensors. In order to analyse how the auxiliaries and the engine temperature influences idling fuel consumption, tests were carried out with and without the auxiliaries switched on, both conditions with the engine at standard operating temperature and at low temperature. Results confirm that with very short idling periods an idling-stop device is not energy efficient since the power provided by the battery to run the starter motor is higher than the energy saved during the engine shutdown. The minimum idling time that permits an energy savings is dependent on the tractor conditions in terms of engine temperature and the switch on of the auxiliaries.