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STUDY ON A BETTER MANAGEMENT IN A MODERN FARM USING DIFFERENT FUELS FOR TRACTOR ENGINES

Mariana DUMITRU

Lucian Blaga University of Sibiu, 10 Victoriei Boulevard, 550024, Sibiu, Romania, Phone/Fax: +40-(269) 21.60.62, E-mail: mariana.dumitru@ulbsibiu.ro

Corresponding author: mariana.dumitru@ulbsibiu.ro

Abstract

In a modern agricultural farm, efficient management of power used in the farm is fully as important as efficient management of machinery. This paper studied the importance of using one or other type of fuels in the final result, which is the efficiency of the engine used by a tractor or other machinery used in the farm. The fuels considered are diesel oil, hydrogen, liquified petroleum gas, premium gasoline, propane, methanol and ethanol. The manager decision of using one or another fuel is based on each fuel energy value, combustion characteristics and economy. The farm manager also must consider the adjustments that must be made to tractor engine if using one or another fuel.

Key words**:** *machinery management****,*** *fuels, tractor engine*

INTRODUCTION

A farm manager must take into consideration many aspects in order to have a performant and competitive farm. One of these aspects is to minimize the cost of machines energy, while maximizing the returns from the farm enterprise. It is known that the 3 components of economic performance are: machine performance, power performance and operator performance [4]. From these 3 components, in this paper we shall refer especially to machines performance. From this point of view, another aspect of a modern and competitive agriculture is that of using the most recent technology by the farmers [7] and also increasing the efficiency of the activity through human resources [9]. When we refer to machines in an agricultural farm, we refer first to tractors, which are indispensable to any farm and then to agricultural machines. Today, all field power comes from internal combustion engines, and most of these engines are mounted in tractors. In this paper, we analyse the tractor engine principles and mechanism, but also we want to show the importance of using different fuels for tractors and agricultural machines. In the beginning, we will present some principles of engine which influence the use of one or another fuel.

The profitability is a fundamental factor in every domain of activity all over the world. The debate regarding optimum capital structure also establishes the link of capital structure with profitability and wealth of shareholders [1].

In this respect, an important factor of profitability in agriculture is the fuel we use for tractors and other agricultural machines. It is well known that old fuels are more and more expensive as the time goes by, that is why the quest for other alternative fuels is a major issue for all researchers. These alternative fuels which are most wanted are especially renewable fuels.

Hydrogen is one of the most promising renewable fuels because it can generate from resources like biomass and water. Hydrogen gas energy carrier is growing fast with the development of fuel cells and its application such as the fuel cell, and hydrogen usage as transportation fuel in the form of a compressed gas. The hydrogen supply options include hydrogen production via electrolysis process, using renewable and carbon dioxide-free electricity sources such as solar, wind or wave powered electrolysis, gasification of coal, petroleum coke and biomass with carbon dioxide capture and storage technology [6].

Labour productivity in Romanian agriculture is one of the most important indicators of economic efficiency. For this reason, it is appropriate to increase this indicator because the ways of increasing labour productivity are means of intensifying the positive action of the various factors that influence it [2].
We consider that studying the engine components and functioning is important if we want to find alternative fuels to feed the tractor engine, as it is well known, high pressure due to the combustion of fuel are brought to bear on the piston head. The connecting rod transmits this force into a torque on the crankshaft (Fig.1).
The number of cylinders used in an engine is a compromise between expense and smoothness of operation. Farm tractors are built with engines having 3 to 8 cylinders. In Fig. 2 is presented an engine with 6 cylinders.

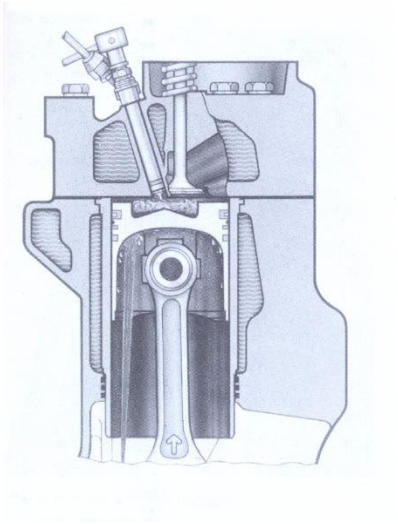

Fig. 1. Basic engine mechanism
Source: [8].

The types of tractors are chosen according to the technological process of the works and the biological properties of crops, following such indicators as ground clearance, gauge, outline dimensions, plot dimensions, energy consumption of machines, soil humidity, and the manoeuvrability of the aggregate.
The choice of aggregates is also based on direct operating expenditures. If two aggregates, after the cost of the works, require the same production costs, choose the one that satisfies the requirements of the machine system. The technical, technological and economic performance of agricultural aggregates is appreciated by the following techniques, also called indices of use or exploitation [3].

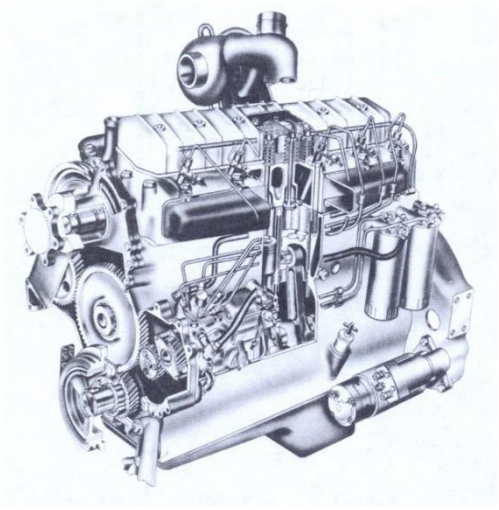

Fig. 2. Six-cylinder diesel tractor engine
Source: [8].

The way in which agricultural land is used by farmers could led to economic efficiency or not. The value of agricultural output is determined by two factors: gross value added and intermediate consumption. Both gross value added and intermediate consumption have a positive influence, meaning that the higher their levels, the higher the agricultural output [10].

MATERIALS AND METHODS

The materials used for this study consist in a tractor engine and different types of fuels with which it has been fed.
Beside the general construction of the engine, another aspect which must be taken in consideration is the valves functioning. Good valves action is essential to proper engine operation. Valves must sat tightly to seal off the combustion chamber during the power stroke. The valve actuating linkage begins at the camshaft with the cam followed or tapped. The tapped lifts the rod, which operates the rocker arm that bears on the valve stem.As the engine temperature rises, this linkage parts expand and would hold the valve open except fot the planned gap or valve train clearance between the rocker arm and the valve stem.this clearance values for farm tractors

range from 0.2 mm to 0.5 mm with the exhaust valve clearance often greater than the intake.

An important role in the best function of tractor engine is played by the fuels used for it [5]. Thus, the availability, energy value, combustion characteristics and economy of the fuel are of prime importance to the machinery manager. Burning of fuels is a chemical oxidation of carbon and hydrogen. Since air is about 23.2 % oxygen by mass, the correct air-fuel ratio is 3,448 units air to 228 units gasoline or 15:1. Other elements enter into the actual combustion equation: large quantities of nitrogen are carried through and elemetar carbon, carbon monoxide and hydrogen.

In Table 1 are presented some of the most important properties of different fuels which the engine can use.

Table 1. Typical properties of fuels

Fuel	Energy per mass [MJ/kg]	Energy per volume [MJ/m]	Octane number	Practical compress ratio
Propane	50.31	25.72	100	10:1
Premium gasoline	47.15	34.33	91	8.5:1
Regular gasoline	47.06	34.63	87	8:1
Diesel fuel	45.46	38.67	40	20:1
Methanol	19.95	15.89	119	12.5:1
Ethanol	26.69	21.18	115	12:1

Source: Own determination and technical data.

RESULTS AND DISCUSSIONS

As it can be observed from Table 1, different fuels have different characteristcs. So, if we want to obtain a good energy per mass, we shall use propane or premium gasoline, but the Diesel fuel numbers are very close to the formers, so we can use Diesel fuel with good results. In what concerns the octane number. It is obvious that the best choice is Methanol or Ethanol, while the Diesel fuel has the worst octane number. But if we analyse the compress ratio of the fuel, we can observe that Diesel fuel has the best compression ratio. In conclusion, the farm manager must make a decision, considering which is the most important characteristic of the fuel he uses at a certain moment.

For carburated engines, volatility, the ability to vaporize is an important fuel property because liquids will not burn. Since refined petroleum fuels are not homogenoeus, the percent of the fuel vaporized at any time depends on the temperature of the fuel at that time. The distilation curves (Fig. 3) show the boiling points of several fuels. The highly volatile liquified petroleum gases, propane and butane are not shown in the chart, these fuels are more homogenoeus because of their simpler molecular structure and they tend to have constant boiling points that depend only on pressure. At atmosphere pressure, propane boils at -42 ^{0} C and butane at 0^0 C.

The low volatility fuels cannot be used conveniently in a carburated engine, but they are commonly used in mechanical fuel injection engines.

Octane rating is the second important fuel property for carburated engines and is related to the ability of a fuel to burn in an engine. Mechanical damage to the engine can result if severe detonation occurs. Detonation is detected as a noise aring from combustion pressure vibrations. These occur when the unburned fuel and air experience spontaneous combustion.

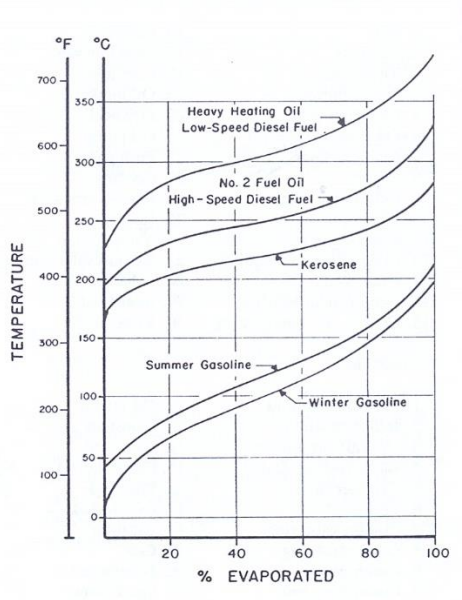

Fig. 3. Distillation curves
Source: Own determination.

Spontaneous combustion temperature may be reached as a result of: engine deposits, overloading and overheating and if the engine compression ratio is too high for the used fuel.

The liquified petroleum gas fuels are natutally highly resistant to detonation, while the heavy fuels are very likely to detonate. Natural gasoline has a moderate octane rating that may be raised greatly with additons of tetraethyl lea, alcohols or other organic compounds.

Diesel engines are subject of detonation also, but an a different way than carburated engines. Diesel fuels detonate because they do not burn fast enough. An ignition delay occurs on injection because the fuel needs to absorb heat and mix with oxygen. The accumulated fuel explodes rather than burns as it is injected.

CONCLUSIONS

In this paper we researched one of the possibilities of increasing productivity in an agricultural farm: using different types of fuels for feeding tractors motor. We presented the most important fuels properties which determines a farm manager to consider a type of fuel used for tractors engines. In the researched we have made, we explained which is fuel characteristic we want to obtain, related to the fuel we use. The main fuels which can be used for tractor engines, depending on these characteristics are: Diesel fuel, hydrogen, propane or premium gasoline.

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