Tractor maintenance to conserve energy

Machinery represents a significant portion of capital costs, second only to land in many farming operations. A well-kept fleet of machinery improves the ability to respond to changing field conditions and other seasonal needs. Past surveys of tractor owners indicate that most are aware of routine maintenance schedules and wish to follow them to protect their equipment investment. Machinery test data supports filter replacement and other general maintenance. When performed at intervals no greater than those listed in operation manuals, the fuel savings are measurable.

Engine maintenance

Efficient combustion of fuel and air inside the tractor's engine directly affects the availability of engine power and fuel efficiency. Filters, usually both primary and secondary, are used to collect small particles and impurities to protect close machine tolerances inside the engine from wear. To maintain a proper fuel and air mixture in the engine cylinders, filters must be replaced on a periodic basis as restricted flow starts to impact combustion efficiency.

In a previous study by ag engineers at the University of Missouri, farmers were invited to bring their tractors to one of six field days at implement dealers around the state. The result was test data on 99 tractors using a power-take-off (PTO) dynamometer. Each tractor was first tested "as is" to determine maximum horsepower available through the PTO shaft. A subsequent test was conducted after replacing the existing air and fuel filters on the tractor with new filters.

After the filters were replaced, average tractor power output increased by 3.5% without further modifications. Filters were replaced on all tractors tested regardless of whether the filters were near the end of useful service life or had been recently replaced. Self-reported oil change intervals and engine oil samples collected and subsequently tested suggest that most tractor operators were following recommended periodic maintenance procedures.

Tests on the 99 tractors indicate that scrupulously following air and fuel filter maintenance procedures results in a 3.5% power increase. Manufacturer representatives confirmed that a 3–4% power increase was normal and expected during filter replacement. Consistent filter replacement maintains the tractor's power output, which is noteworthy since a new tractor currently costs approximately $700 per horsepower depending on its size and options. Making an additional 3.5% of power available on a 200 hp tractor is equivalent to adding 7 hp—a value of nearly $5000 when considering the initial cost of a new replacement tractor.

Alternatively, fuel flow from the throttle could be reduced 3.5% to produce an equal power level after the filters were replaced. Fuel use savings per tractor on smaller (~ 140 hp) tractors being used at the time was estimated to be 105 gallons/year. Larger tractors would be expected to save proportionately more depending on use.

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As further evidence of the importance of filter maintenance, combustion power output is directly related to air pressure available to fill the combustion cylinder. A vacuum drop of 0.5 psi air pressure across an air filter results in 3.5% less air entering the cylinder in a naturally aspirated engine. The relationship in a turbocharged diesel engine is more complex, but results in a similar trend if oxygen is limited for combustion.

Combustion efficiency is significantly affected by maintaining engine operating temperature within a certain range. In addition, engine wear increases rapidly if lubricating oil breaks down at high temperatures or water condenses at lower temperatures and reacts with sulfur compounds to create corrosion. Engine operating temperature should be carefully monitored. Thermostats on many engines open around 180°F, but consult the operation manual. Cooling system maintenance should include periodic inspection and replacement of coolant and possible replacement of the engine thermostat if it is defective in maintaining proper engine temperature.

Letting a diesel tractor engine idle for a few minutes following hard work allows circulation of cooling oil. Before idling for 8–10 minutes, check the operator's manual. Newer tractors may require 3–5 minutes of idling or less. Road transport at a lower engine speed before shut off may eliminate the need for cool down idling. Ten minutes of excess idling consumes a half gallon of fuel or more on a larger tractor used for tillage.

Fuel supply

Diesel fuel forms waxy, solid crystals at low air temperatures common during cold weather operation. The temperature at which diesel begins to "cloud" as solids begin to form depends on the diesel refining process. Unfortunately, refining that lowers the cloud point for cold-weather diesel operation also slightly reduces the energy content per gallon of fuel. The result is common use of #2 diesel fuel during warm weather operation, but switching to #1 diesel during cold weather. Using #1 diesel reduces the potential for plugging filters or fuel injection systems due to its lower cloud point, but fuel energy per gallon is also slightly reduced. Fuel supplies should be switched from #2 to #1 as the climate cools in late fall, but back again to #2 when air temperature warms for springtime operations. If a supply of #2 fuel must be carried into colder weather, fuel additives are available.

A tractor engine block heater is commonly used to warm the engine and aid starting for cold weather operations such as snow clearing or livestock chores. Conserve energy by plugging the heater into a timer to heat the engine for 2–3 hours before starting rather than operating the heater overnight. Also keep the fuel tank relatively full during cold weather. If air inside the tank is cooled below its saturation point (dew point), vapor condenses into water and may cause potential fuel problems.

To reduce fuel loss due to evaporation, use white or aluminum-colored paint on above-ground fuel storage tanks unless another color is required by local fire code. Shade or paint that reflects solar radiation helps to reduce fuel evaporation. Use a vacuum and pressure-relief valve on large fuel supply tanks to reduce evaporation loss due to pressure changes inside the tank. For onboard fuel tanks, use a vented or unvented fuel cap per manufacturer recommendations.

Summary points:

- Be vigilant in following air and fuel filter replacement as well as other engine maintenance procedures. Staying current on filter replacement saves 3–4% of fuel or more.
- Observe engine temperature and air filter/pressure indicators during operation for any significant changes that might affect fuel economy.
- Avoid excessive idling to cool engine.
- Use a timer with an engine block heater to avoid unnecessary heating.
- Protect fuel from evaporative gasses and select appropriate fuel for summer/winter operation.

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