

Above Ground

Gasoline Storage



*for
Your
Farm*

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Tanks used for one series of tests.

Gasoline Storage For Your Farm

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With farms becoming more and more mechanized, the amount of money farmers spend for fuel is climbing rapidly. Fuel costs are estimated to be as much as 5 to 7 percent of the total farm operating expense.

Oil companies are supplying us with gasoline of good quality. It has an octane rating that is suitable

for present day tractors. It will evaporate fast enough to assure quick starting and warm up. It has additives to retard the formation of gum.

Guarding the investment made in this high quality fuel is good business. Good farm fuel storage will maintain fuel quality, keep the fuel clean, and hold evaporation losses to a minimum.

Answers Sought in Research

A research program on farm fuel storage has been completed.* The study was made to determine the answer to a number of questions:

1. What effect does the color of the tank have on fuel temperature, evaporation losses, and fuel quality?
2. Does placing the storage tank in the shade improve storage conditions?
3. Is storage improved by keeping a slight pressure in the tank?
4. How many dollars worth of gasoline might evaporate from a farm storage tank in a year?

*The Missouri Farmers Association Oil Company of Columbia, and the Ethyl Corporation Laboratory of Kansas City, Missouri were cooperating agencies.

The research was carried out in farm-size containers and gasoline was withdrawn during the tests, to make conditions similar to those on a farm. Gasoline was stored in a battery of tanks and factors such as tank color, shade, and pressurized storage were evaluated.

In one test the storage containers were 55-gallon drums. In another, common farm storage tanks of approximately 300-gallon capacity were used. In a third test, pressure-vacuum release vents were used. Such vents are designed to maintain a slight pressure in the tank.

Gasoline's "Boiling Points"

Gasoline is a rather complicated fluid, being a mixture of several different petroleum products. Each of the products has a "boiling point" temperature. When gasoline is heated each of the various fluids that make up the mixture "boil off" at some temperature.

A curve called a distillation curve is plotted from information obtained by slowly heating a sample of gasoline and finding out how much "boils off" at each temperature.

Indication of Starting Quality

The curve tells a lot about the gasoline. The lowest temperature at which any of the gasoline "boils" gives some indication of how easily an engine might be started if it were burning that particular gasoline. The best indication of the starting characteristics of a gasoline, however, is the temperature at which 10 percent of the fuel is "boiled off."

The top curve at right (Figure 1) is a distillation curve for a winter grade gasoline. Ten percent of the fuel is evaporated at 101° F. The dotted line on the lower curve (Figure 2) shows the distillation curve after the gasoline had been stored for 6 weeks in a 55 gallon drum during the winter time. *The drum was painted red, had no shade, and was equipped with a filler cap that was freely vented to the atmosphere.*

After storage, it took a temperature of 128° F to evaporate 10 percent of the fuel. Thus, other things being equal, it would be harder to start an engine with this fuel after it had been stored.

Indication of Quick Warm-Up

The temperature at which 50 percent of a fuel is evaporated gives an indication of how quickly an engine will warm up when using the fuel. Here, again, the test fuel was better going into storage than it was after 6 weeks of storage. The 50 percent point was 204° F after storage and 167° F before storage.

The drum the fuel was stored in allowed the "lighter" liquids in the fuel to evaporate.

Fig. 1—Distillation Curve for a Typical Winter Grade Gasoline.

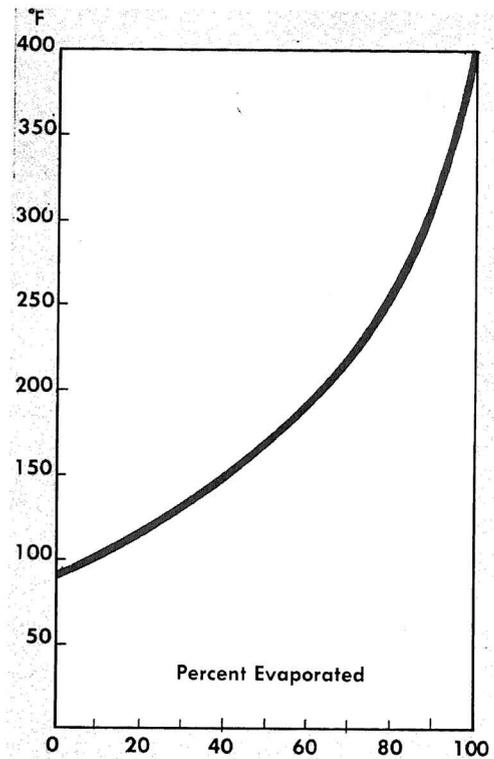
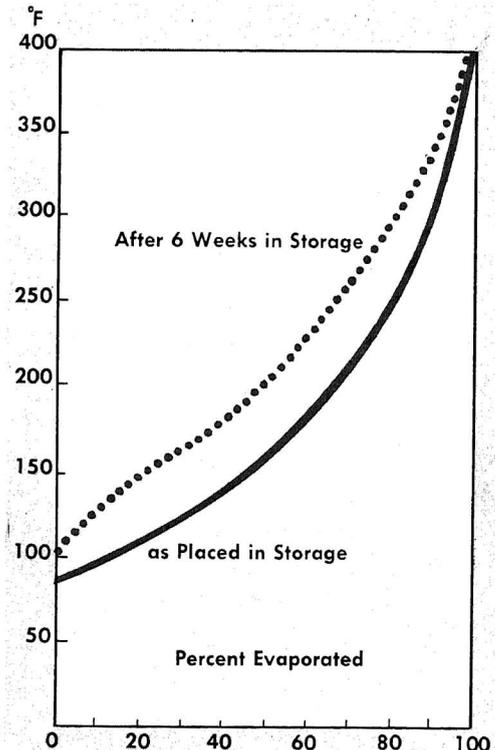


Fig. 2—Curve Shown in Fig. 1 Compared with Curve of Same Gasoline After Six Weeks Storage in a Red Drum in the Sun.



Gasoline Temperature

The temperature of gasoline in storage is important. If it reaches a temperature where the "lighter" liquids "boil off" there will be losses by evaporation.

Tank Color

One aspect of the research was to determine the effect of tank color on the temperature of the gasoline in the tank. The curves (Figure 3) illustrate results of the tests. On a typical summer day, the gasoline peak temperatures were 99° F in a red tank, 97° F in an aluminum tank, and 95° F in a white tank. With the white tank in the shade, gasoline temperatures reached 93° F.

The difference in gasoline temperatures appears to be important. The temperature at which the "lighter" ends evaporate rapidly will usually be between 90 and 100° F. Therefore, gasoline losses from a tank that is vented to the atmosphere may be rather large at 99° F and much less at 95 or 93° F.

Shade

The lower set of curves (Figure 4) answers a question that has often been asked: "Does color make a difference if the tank is placed in the shade?"

Figure 4 shows there was little difference in temperature of the gasoline in the red tank and in the white tank when they were both placed in the shade.

In both tests (represented by the two sets of curves) the maximum spread in gasoline temperature between shaded storage and storage in a red tank in the sun was 6 or 7 degrees. This is an important difference as will be shown when evaporation losses are presented.

Another important factor in gasoline storage is the *length of time* during the day that gasoline temperature remains high. For example (from the lower set of curves) the gasoline in shaded storage was above 90° F for 3 or 3½ hours. On the same day the gasoline in the red tank in the sun was above 90° F for 6 or 7 hours.

Fig. 3—Effect of Tank Color and Shade on Temperature of Gasoline.

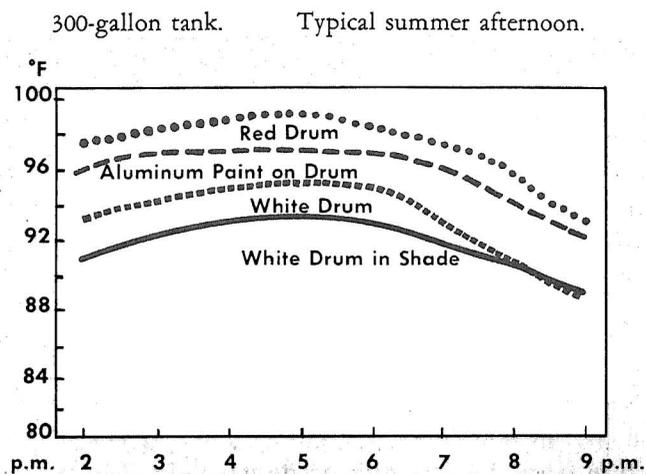
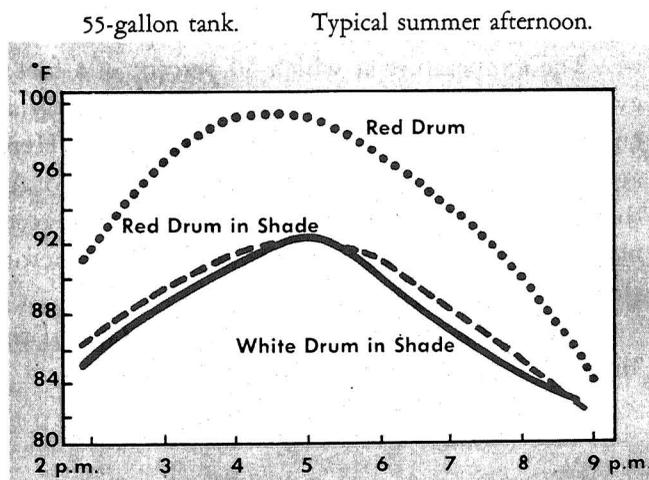


Fig. 4—Effect of Tank Color and Shade on Temperature of Gasoline.



Evaporation

Evaporation losses can add more than ½ cent per gallon to the tractor fuel bill. The graph at right (Figure 5) shows how these losses may be reduced.

The losses shown are based on the tests with the 300-gallon storage tanks. A loss of 32 gallons for each 1000 gallons used is a loss of 3.2 percent. Painting the tank a light color reduces the loss to 20 gallons per 1000 gallons used. A real saving, however, can be made by placing the tank in a good shade or using a special vent to keep the gasoline under a slight pressure.

When 55-gallon drums are used for gasoline storage, evaporation losses are greater (on a percentage basis) than when 300-gallon tanks are used. The red drum placed in the sun lost 10 gallons out of 150 or nearly 7 percent (Figure 6). This can be compared to the 3.2 percent loss from the 300-gallon red container placed in the sun.

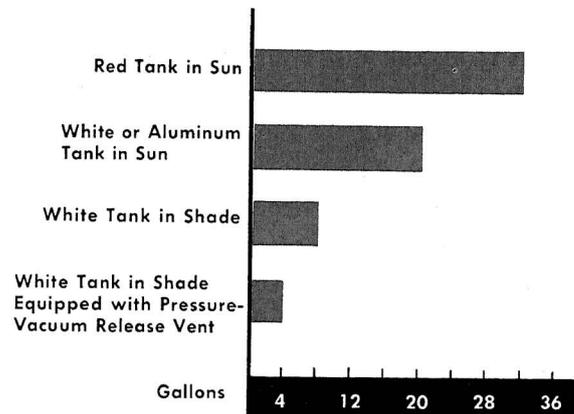
In this test the losses were reduced from 10 gallons to 4 gallons by placing the tank in the shade. The temperature curves show that tank color has little effect on gasoline temperature when the tank is placed in the shade. Shaded storage containers of any color will save gasoline. Again, the least loss is from the pressurized storage.

Less gasoline is used in the wintertime, but evaporation losses (per gallon stored) are not reduced. The graphs (Fig. 7) show that in the test the percentage losses increased.

In the wintertime the gasoline delivered to the farm is manufactured to evaporate faster at outdoor temperatures in order to make it easier to start engines. That means that on a day when the sun shines on the tank, losses will be high.

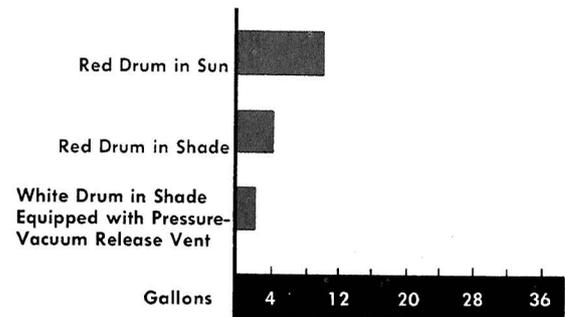
In this test, as in the other two, the pressurized container held evaporation losses rather low. Losses from a red drum placed in the sun were nearly 10 percent.

Fig. 5—A Summer's Evaporation Losses per 1000 Gallons of Gasoline Stored in a 300-Gallon Container.*



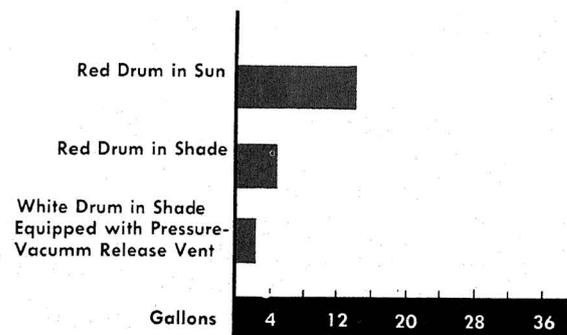
*75 gallons were withdrawn each week to simulate farm conditions.

Fig. 6—A Summer's Evaporation Losses per 150 Gallons Stored in a 55 Gallon Drum.*



*12½ gallons were withdrawn each week to simulate farm conditions.

Fig. 7—Winter Evaporation Losses per 150 Gallons of Gasoline Stored in a 55 Gallon Drum.*



*12½ gallons withdrawn each week to simulate farm conditions.

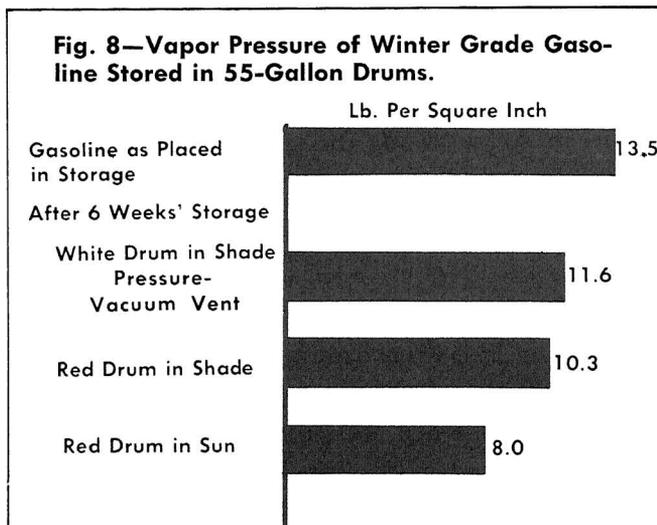
Vapor Pressure

There is a difference between winter grade gasoline and summer grade gasoline. One of these differences is in the vapor pressure. Vapor pressure might be considered the pressure the liquid is exerting to drive the surface molecules away (or make them evaporate). The higher the vapor pressure the faster the evaporation. Alcohol and ether, for example, have a higher vapor pressure than water, and therefore, evaporate much faster.

The vapor pressure of the gasoline used in one of the winter tests was 13.5 pounds per square inch (p.s.i.) (See Fig. 8). After 6 weeks in storage the vapor pressure of the gasoline stored in a red tank placed in the sun was 8.0 p.s.i. The 8.0 p.s.i. is the vapor pressure of a summer gasoline. In other words, the manufacturer delivered a winter gasoline but storage conditions changed it to a summer gasoline.

The gasoline in the pressurized drum had a vapor pressure of 11.6 p.s.i. after 6 weeks of storage.

This gasoline would still be considered winter grade. The tank in the shade contained gasoline that would be recommended for fall or spring use, but its vapor pressure was a little low for winter grade.



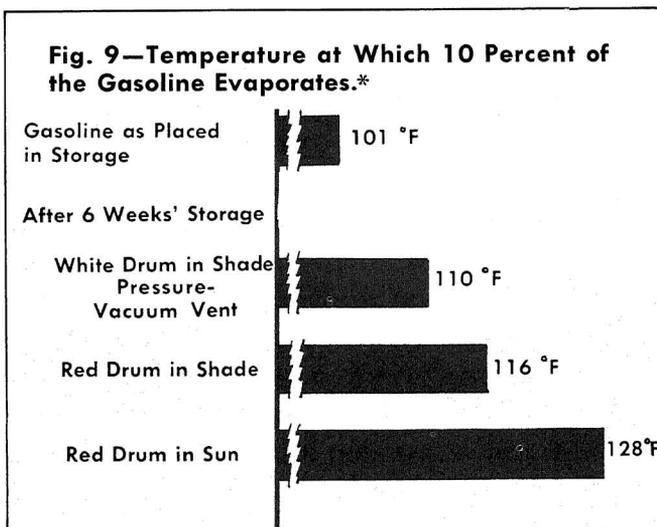
Temperature at 10 Percent Point

The temperature at which 10 percent of the gasoline “boils off” during the distillation test is related to some extent to the vapor pressure. The graph (Figure 9) shows the 10 percent point temperatures for the same tests for which vapor pressures are given. The lower the vapor pressure the higher the temperature required to distill 10 percent of the gasoline.

The temperature at which 50 percent of the gasoline “boils off” also increases as vapor pressure decreases.

This means that an engine using a gasoline that has a low vapor pressure and a corresponding high 10 percent point temperature will require a good deal of choking. Also, it will warm up slowly. There will be more cylinder wall “washing” from unevap-

orated gasoline with a corresponding increase in engine wear.



*From distillation tests of winter grade gasoline stored in 55-gal. drums.

Pressure-Vacuum Release Vents

The results of the tests show that storing gasoline in a container that is held under a slight pressure will save gasoline. The gasoline that is saved is part of the "lighter" ends, which means that the vapor pressure will not drop excessively in storage. Engines started with gasoline stored in this manner will start with less choking and will warm up faster. This means less engine wear.

In one series of tests the gasoline temperature was held at 100° F and the pressure-vacuum vents were effective in retarding evaporation losses. Gasoline, even when stored in the sun, did not reach temperatures above 100° F.

The vents are designed to seal the tank under a slight pressure as gasoline temperatures increase. They are also equipped with a release valve to bleed air into the tank when gasoline is drawn from the tank or when the tank cools at night.

Shade

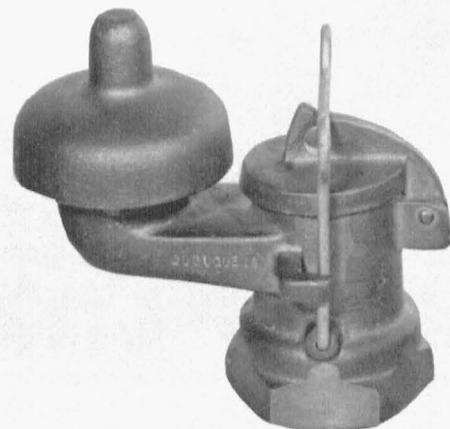
Good shade keeps gasoline cool. Losses by evaporation are less when the tanks are shaded and gasoline temperature is reduced. While such losses are double those from the tanks equipped with the pressure-vacuum release vents, the amount saved represents a large saving.

The shades used in the tests had two features that made them effective. (1) They did not allow the sun to shine on the storage tank at any time during the day. (2) They were constructed to permit air circulation just under the roof to keep the warm air from being trapped around the tank. (See cover picture for a sample of a good type of shade. Note open front and slit at the top in back to allow circulation and prevent hot air from collecting.)

A dense shade tree that provides shade from sun up to sun down might do a good job of shading the tank. However, it is possible that some of the loss due to evaporation is the result of wind motion around open vents. This may siphon gasoline vapors from the tank. Sheet metal shades may serve to block off the wind and reduce gasoline losses in this manner.



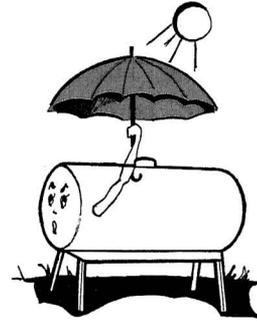
The conventional filler cap, above, is freely vented to the atmosphere and does not protect much from evaporation. Below are three types of pressure-vacuum vents that retard evaporation.



Gasoline Storage Recommendations

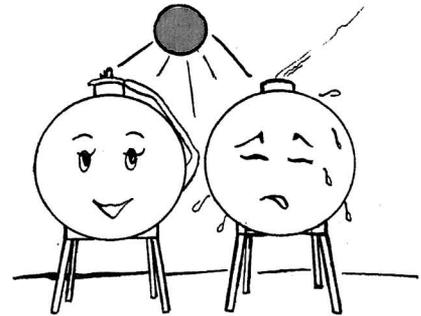
Keep gasoline cool

- Provide a good shade



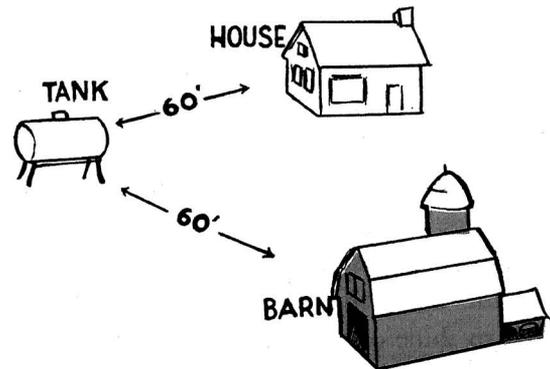
Reduce evaporation losses

- Equip tank with a pressure-vacuum release vent.



Store gasoline safely

- Locate tank 60 feet from buildings.
- Place tank on a well built stand for support.
- Ground the tank for lightning protection.
- Print or stamp the word "Gasoline" on the tank.
- Print or stamp the words, "Inflammable—Keep Fire and Flame Away" on the tank.
- Have a fire extinguisher handy.



Handle gasoline with care

- Do not smoke or light matches around fuel.
- Use a hose to transfer gas from the tank to the tractor.
- Shut off the engine while refueling the tractor.

