Oakland CUSD #5

Ag Mech

April 13-17, 2020

Jeff Coon

Week of April 13-20, 2020

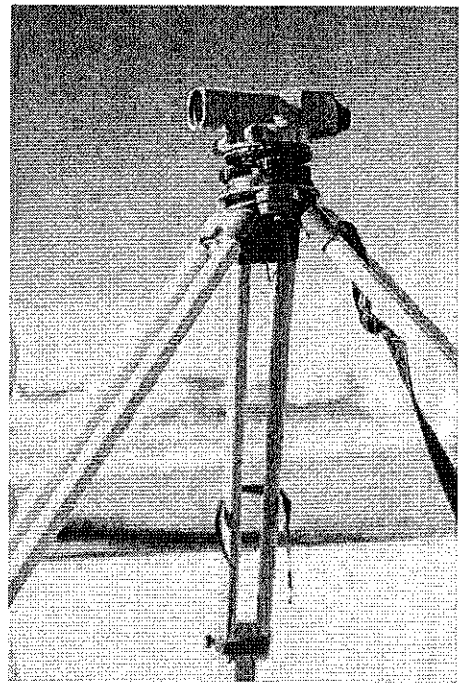
All of these assignments are on google classroom. You must pick one of the 3 listed and complete by next Monday April 20 for credit. If you would like to use google docs to complete the work that would be most efficient, just remember to start a new copy with your own work please. Paper copies can be returned to the school.

Class	Choice 1	Choice 2	Choice 3 (Enrichment)
Ag Science	Animal Cell	Heredity and DNA	FFA journal
Ag Business Mang	Managing Employees	Employee benefits	Chart work experiences
BSAA	Animal Cell Structure	Animal Growth factors	Animal Nutrition 2
Landscape Design	Soil Texture	Water Holding Capacity	Landscape pests
Intro To Ag	FFA official dress	FFA opportunities	Ag Commodities
Ag Mech.	Surveying Equipment	Fuels	Lubricants

Ag Mech April 13-17 Choice 1

Surveying Equipment

WHILE SURVEYING is a vital component to description of property boundaries, many additional applications of surveying exist in daily life. From the construction of buildings and the installation of field tiles to the construction of race tracks and golf courses, surveying applications are all around us. Knowing the various types of surveying equipment and how to properly use them may open the door to various career opportunities.



Objective:

- Identify and demonstrate the use of surveying equipment.

Key Terms:

- chaining ring and pins
- hand-sighting level
- leveling rod
- plumb bob
- tape measure
- taping
- tripod
- tripod level

Basic Principles of Surveying

When conducting surveys, calculation of slope is essential to survey completion. A common equation for finding slope is "rise over run" or dividing the height by the distance. However, simply knowing the equation will not lead to a successful survey. A person must be able to properly identify and use surveying equipment.

SURVEYING EQUIPMENT

The first measurement needed to calculate a slope is the horizontal distance between two points.

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Tape Measure

A **tape measure** is a device used to measure the distance between two points. Tape measures may differ in lengths, material, measurement unit, and/or encasement type. When using a tape measure, a crew may use a chaining ring and pins.

Chaining Ring and Pins

A **chaining ring and pins** is equipment set as markers to measure over long distances. This set includes a ring and 11 pins for marking points along a course.

Leveling Rod

A **leveling rod** (target rod) is a device used to measure the difference in vertical height between two points. When using a target rod, the person holding the rod must tilt the rod from side to side as well as forward and back to ensure an accurate reading. Over large distances, this is accomplished through the use of hand signals between crew members.

Hand-Sighting Level

A **hand-sighting level** is a simple instrument used to make approximate measurements when sighted in upon a target rod. The major components of a hand-sighting level include crosshairs for sighting in upon the target rod, a bubble tube for leveling accuracy, a mirror for bubble tube reflection to the viewer, and an eyepiece for viewing ease.

Tripod

A **tripod** is a three-legged platform used to create a steady surface from which to survey. Attached to the base of the tripod is a **plumb bob**, which is a weight attached to a string to ensure that the tripod is over an exact point.

Tripod Level

A **tripod level** is an optical instrument mounted to a tripod for elevation readings. Tripod levels vary greatly in type, accuracy, and cost because types range from basic levels to expensive laser levels. In spite of their complexity, all levels have the same basic components: a telescope, a leveling device with three or four screws, a leveling plate, and a head for attaching the transit to the tripod.

CONDUCTING A TAPING EXERCISE

When surveying first began, actual chains that were 66 feet in length were used to measure distances. The process was known as chaining. Today, the measurement is known as **taping**—the use of measuring tapes to determine a land distance from point to point. Tapes used in surveying are most often graduated in feet (one-tenth and one-hundredth of a foot) and can be

found in a variety of lengths. Survey lines are measured in full tapes or stations, plus a final distance of less than 100 feet. Fractions of a foot are indicated in decimals to the nearest 0.1 or 0.01 foot, depending on the accuracy required.

Equipment needed for taping includes a field notebook, a steel or nylon tape with a reel, a chaining ring with 11 pins, and a plumb bob. Nylon tapes are accurate enough for most agricultural surveying. As they get older, nylon tapes may stretch slightly, so they should be checked periodically with a steel tape for accuracy. A taping crew includes at least two people. One person acts as the head tape person, and the other person acts as the rear tape person. A third person may serve as a note keeper.

TABLE 1. Taping Procedures

1. The head tape person picks up the ring of marking pins and sets one pin at the starting point.
2. The head tape person takes the zero end of the tape and advances in the direction of the line to be measured, pulling the tape behind. The rear tape person stands at the starting point.
3. When the 100-foot end of the tape comes even with the first pin, the rear tape person calls "tape."
4. The head tape person then sets a pin even with the zero mark.
5. The rear tape person then pulls the first pin and both advance down the line to be measured.
6. This same procedure is repeated for each 100 feet. At all times, the number of pins in the rear tape person's hand indicates the number of 100-foot lengths that have been measured. The pin in the ground is not counted.
7. When the head tape person has set the eleventh, or last pin, the rear tape person delivers the other 10 pins to the head tape person.
8. When the last distance to be measured is a fractional tape length, the pin at the last even 100-foot mark or station should not be pulled or counted.
9. Read the final measurement accurately, and add this plus-station to the distance, which has already been measured in even 100-foot stations.

USING A HAND-SIGHTING LEVEL

The hand-sighting level, or hand level, is a simple instrument for approximate measurements over short distances. It consists of a sighting tube with a horizontal cross line to mark the line of sight, a bubble tube, and a small mirror to reflect the bubble through to the eyepiece. When the bubble is centered in sight-

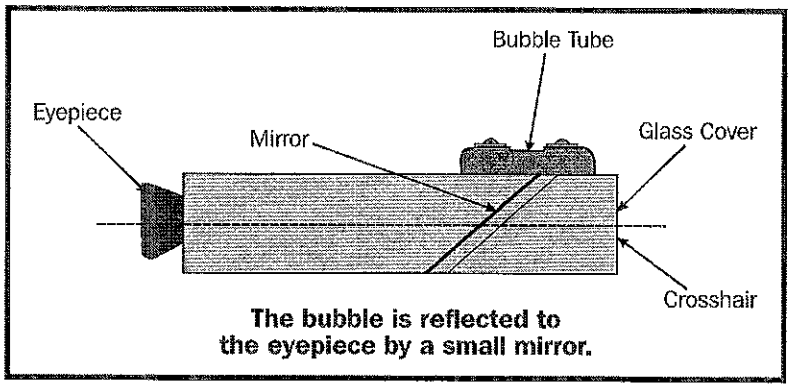


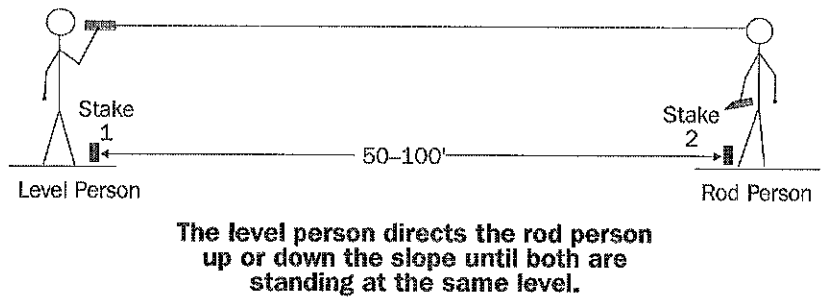
FIGURE 1. This is a hand-sighting level.

ing, the crosshairs project a level line of sight. While ease of use is an advantage, accuracy and the ability to read over long distances are limitations of the hand-sighting level. Hand levels are most often used for finding contour lines and calculating slope.

Finding Contour Lines

Contour lines are used to identify points of land at the same level. They may be useful in designing waterways, ponds, and various land structures that require even points. The following are the steps for finding contour lines. It will take two people to perform this activity. One person will act as level person and the other as rod person.

To begin, the level person will stand on a level spot facing the rod person, who should be about a step away. The level person should look through the hand level and find the measurement on the rod that is level with his or her eyes. The rod person will set stake number 1 to mark the start of the contour line. The level person should then stand at this stake and direct the rod person to move a specified distance along the approximate contour line. The level person should direct the rod person up or down the slope until the rod is located at the same level. The rod person should then set stake number 2, which will be on the contour line. The crew should repeat this process until the entire contour line has been located.



The level person directs the rod person up or down the slope until both are standing at the same level.

FIGURE 2. This is the process of locating contour lines.

Calculating Slope

Calculation of slope is necessary for many tasks. Road construction and field tiling are two examples of the many ways that slope calculations are used. The following are the steps needed to measure and calculate slopes when using a hand level.

To measure slope, two people are needed: one with a hand-sighting level and the other with a leveling (target) rod. Mark the two points to be measured with a flag. The point lowest on the slope should be labeled Point A, and the point up the slope should be Point B. Use a measuring tape to measure and record the distance between the two points. Once the distance has been determined, the level person should move to a location from which to take both readings. The rod person stands at the first point (Point A) on the slope to be measured and holds the target rod so it is visible to the person taking the level readings. The level person takes the reading on the first point (Point A), making sure to use the hand level correctly. The rod person should then move up the slope to Point B. The level person should then take a reading on the rod at Point B.

After all measurements have been taken, the difference between the two rod readings should be divided by the distance traveled by the rod person and multiplied by 100. This will

determine the percent slope. By placing Point A as the lower point on the slope, the target rod measurement will be the larger of the two measurements. If you were to switch A and B, you would calculate a negative number for the difference. If this occurs, simply remove the negative to make the difference positive, and calculate as previously instructed. You should not provide a negative slope percentage as the answer.

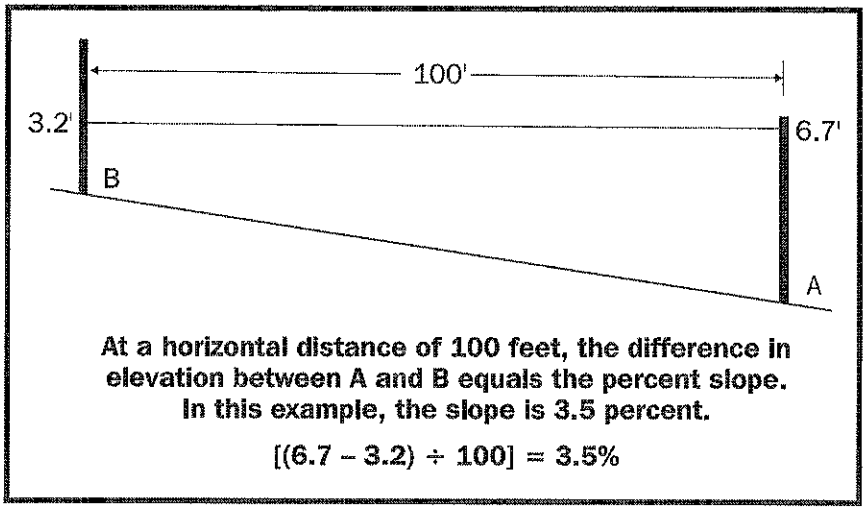


FIGURE 3. Measuring slopes.

LEVELS WITH TRIPODS

The accuracy and measuring ability of a level vary greatly from one type to another. One way to increase the accuracy of a level is to choose a type that attaches to a tripod. A tripod level, also known as a transit, is more advanced and requires additional training to maintain and operate it correctly. It is, however, able to achieve a greater level of precision. When operating a level, three basic tasks should be understood by a surveyor to ensure proper use. These items include:

Caring for the Level

To ensure accuracy, you need to use the level properly and handle it with care. The following are suggestions that should be followed concerning the care and handling of the leveling instrument:

- When transporting the instrument, protect it from shock and vibration.
- Keep the instrument in the box provided, except when in use.
- When the instrument is removed from the box, place the lens cap and tripod cap in the box.
- Close the box and place it where it will not be damaged while the instrument is in use.
- Thread the instrument onto the tripod carefully, and make sure it is firmly fastened before picking it up.
- Carry the tripod and instrument on your shoulder when in the open, but hold it under your arm with the telescope in front when passing through brush or inside an enclosure or building.

- Never run with the instrument because this increases the chance of falling and breaking it.
- Never force the screws or other moving parts because they may be damaged.
- Loosen the tripod leg fasteners before picking up or setting down the instrument.
- Tighten leveling screws snugly, but do not force them. Make sure each leveling screw is snug against the plate before adjusting the level.
- Do not carry the instrument while crossing a fence.
- Protect the lens from the direct rays of the sun by using a sunshade at all times.
- Clean lenses only with soft tissue, not with your fingers or rough cloth, and do not remove the lenses.

Setting Up the Tripod Level

Setting up the tripod level could be considered the most important part of completing a leveling exercise. If the level is not set up properly, all of the collected data will be incorrect, thus leading to wasted time and money. To set up the tripod level, complete the following steps:

- Make sure the tripod legs are free to adjust in length. This may be accomplished by loosening screws, releasing clamps, etc.
- Adjust the tripod legs so the tripod plate is approximately level. On hillsides, place one leg on the uphill side and the other two on the downhill slope to increase stability.
- Spread the tripod legs so the instrument will be stable and the telescope will be at eye height.
- Push the tripod legs firmly into the soil.
- Double check the levelness of the tripod plate, and make the tripod legs fixed so they will not move or slide.
- Remove the tripod cap, and place it in the instrument box.
- Lift the level from its case by lifting on the frame, not by grasping the telescope.
- Fasten the instrument carefully and securely onto the tripod, being careful not to damage the threads.
- Remove the lens cap and place it in the carrying case.

UNDER INVESTIGATION...

LAB CONNECTION: Surveying Equipment Identification

With the assistance of your instructor, assemble and/or identify the different pieces of equipment used in surveying. In a chosen format, provide an image to identify each piece of equipment, point out the individual parts of each item, and note the proper use of each item. Possible methods to display the information include computerized presentations, video demonstrations, sample Web sites, and posters.

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- Place the sunshade on the telescope. Some models have a built-in sunshade.
- Place the instrument case in a safe location.
- Loosen the telescope clamp, and move the telescope until it is in position directly over an opposite pair of leveling screws. Adjust the four leveling screws so they are snug against the leveling plate.
- Tighten one leveling screw, and loosen the other simultaneously to center the bubble. (The bubble follows the left thumb.)
- Rotate the telescope to a position directly over the other pair of leveling screws, and again center the bubble.
- Repeat this leveling procedure for each pair of screws until the bubble stays level for a complete revolution of the telescope.
- Turn the telescope to bring the target rod into the field of focus, using the fine adjustment screw.

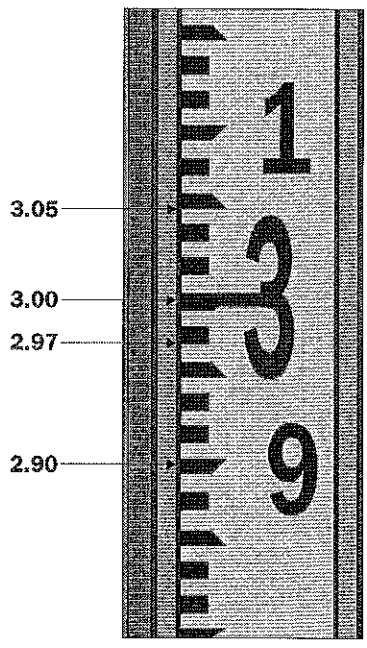
Moving the Level

When it is necessary to move the level, the leg clamps should be released; the legs should be lifted from the soil; and they should be folded together. The legs should be re-tightened so they are as compact as possible. Care should be taken when transporting so as not to strike any objects with the level. When the new location for the level has been reached, the steps for setting up should be followed.

THE LEVELING ROD

A leveling rod is generally used with a tripod level to measure a vertical distance from the line of sight down to a point. It may or may not have a sliding sight, or target, for use in making readings. The most common type of rod used for agricultural applications is called a self-reading rod. It can be read through a telescope without the use of a target.

To read a target rod, you must understand what each component means. For instance, a large red number marks each foot. Each one-tenth of a foot is marked with a smaller black number. In addition, the black and white segments identify one-hundredth of a foot in width. Readings are made at the top and bottom of these black segments. The top edges of black segments are even one-hundredth of a foot values, while the bottom edges of black segments are the odd one-hundredth of a foot values. A two-person crew uses a variety of hand signals to indicate the direction in which the leveling rod should be moved.



On the leveling rod, the large, red number 3 reads 3.00 feet. The smaller, black numbers read one-tenth of a foot.

FIGURE 4. This is a leveling rod.

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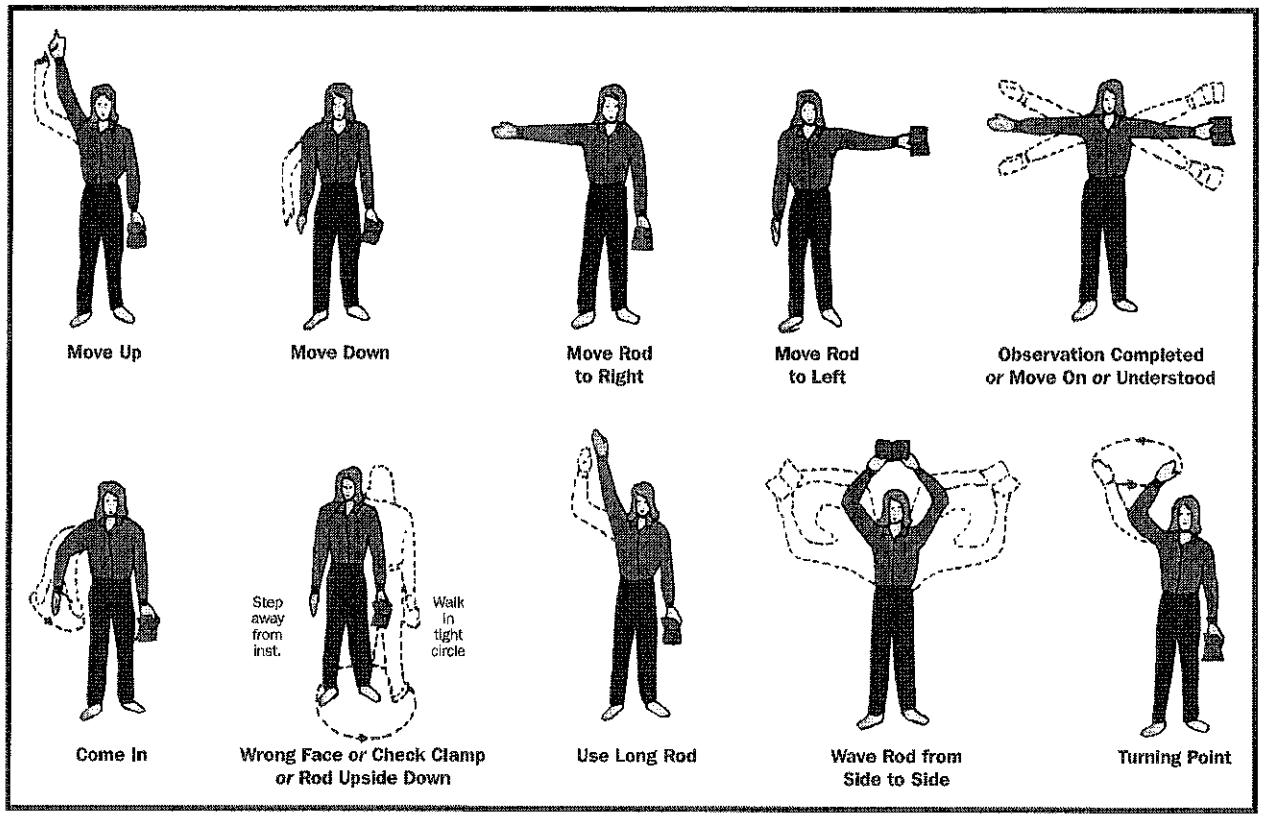

FIGURE 5. Leveling rod hand signals.

LASER LEVELS

Many professionals involved in surveying use laser levels for their ease of operation and accuracy. Additionally, laser levels allow one person to do simple surveys (e.g., slope measurements) without assistance. To take a reading, a laser level projects a beam through a prism toward the target rod. A detector on the target rod is moved up or down. Once the beam intersects it, the reading is complete.

Laser Level Procedures

- Attaching the laser level to the tripod
- Turning on and calibrating the laser level
- Moving the target rod and detector to the station to be measured
- Adjusting the detector in height until the laser level beeps—this identifies that the level reading may be recorded

Summary:

There is a wide variety of surveying equipment from which to conduct surveys. From basic hand levels to precision laser levels, accuracy of any survey is the key to

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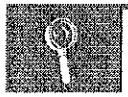
obtaining reliable results. While many choices for equipment exist, the calculation of slope is always constant and may be figured by taking the difference in elevation between two points, divided by the distance in between them, and dividing that figure by 100 to achieve the percent slope. Calculation of percent slope is useful in many agricultural and industrial applications.

Checking Your Knowledge:

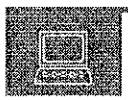
1. How does a person calculate slope?
2. Why does a tripod help with surveying accuracy?
3. What procedures may be completed with a hand-sighting level?
4. How are target rod markings interpreted?
5. Why would a person use a laser level instead of a hand level?

Expanding Your Knowledge:



Visit a job site where surveying is taking place. Work with the surveying technician to understand the procedures for conducting a survey in the real world. While you are working, document the steps necessary to complete the survey.

Web Links:



Agricultural Career Profiles
http://www.mycaert.com/career-profiles

Instruments Used in Surveying
http://www.agriinfo.in/?page=topic&superid=8&topicid=45

Laser Levels
http://stream.fs.fed.us/news/streamnt/jul96/jul96a5.htm

Surveying Equipment
http://www.state.nj.us/transportation/eng/documents/survey/Chapter5.shtm

Surveying Equipment Basics
http://www.benmeadows.com/refinfo/techfacts/techpdf/survey_equipment_1360.pdf

Use a Transit
http://www.grounds-mag.com/mag/grounds_maintenance_transit/

Choice 1

Ag Mech Mr. Coon April 13 Name

Checking Your Knowledge:

1. How does a person calculate slope?

2. Why does a tripod help with surveying accuracy?

3. What procedures may be completed with a hand-sighting level?

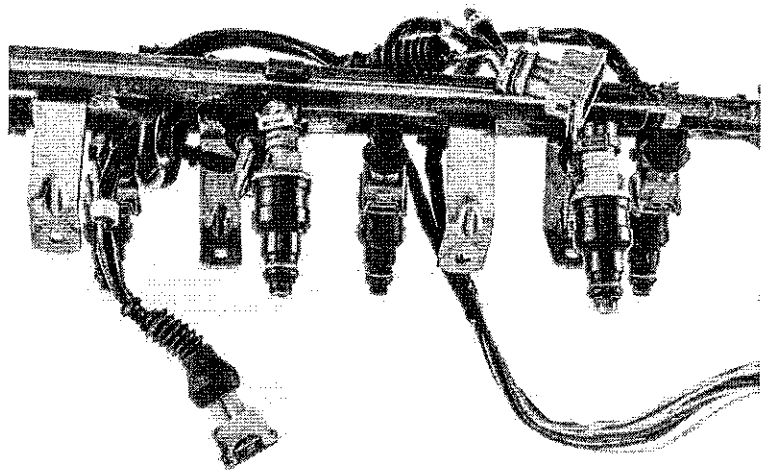
4. How are target rod markings interpreted?

5. Why would a person use a laser level instead of a hand level?

Ag Mech April 13-17 Choice 2

Fuels

IN AGRICULTURE, fuel is an important resource because it is used in tractors, trucks, semis, lawn tractors, and many small engine implements. Fuel is refined from fossil fuels that have been used for millenniums. However, each fuel type is a bit different in its unique qualities and how it is used. Each fuel is different. Because of the difference in the way the fuel is ignited, gasoline, diesel, and LP gas engines require fuel with certain qualities.



Objective:

List and describe the many facets and safety practices when working with or around fuels in agriculture.

Key Terms:

ash content
bottom dead center
carbon residue
cloud point
compression ratio
E-85 fuel
fermentation
flash point
octane rating
oxidative stability
pour point
top dead center
viscosity
volatility

Understanding Fuels Used in Agriculture

Various fuel types are used, depending on factors such as the equipment type, price, and availability.

April 13-17 Choice 2

REGULAR UNLEADED

Regular unleaded gasoline is used in spark ignition engines. The charge of fuel and air is taken into the cylinder as a mixture, is compressed, and is ignited by the spark plugs. The compression ratio for gasoline engines is 8 to 1 or 9 to 1.

Compression ratio is the relation between the total volume inside the cylinder when the piston is at bottom dead center compared to when it is at top dead center. **Bottom dead center** is a situation in which the piston is at its greatest distance from the cylinder head. In contrast, **top dead center** is a situation in which the piston is closest to the cylinder head. The higher the compression ratio, the more the fuel-air mixture is compressed and the higher the pressure inside the cylinder before the fuel burns. If the fuel burns properly, higher compression greatly increases the power output of the engine because more of the fuel energy is developed into useful power.

DIESEL FUEL

When using diesel fuel, there is no spark to start the fuel burning. The air is compressed until it is so hot that fuel injected into it will spontaneously start burning. During injection, it is vital that the atomized fuel particles are fully mixed with the molecules of hot compressed air so the maximum possible numbers of ignition points are created throughout the charge to provide early and uniform ignition. The compression ratios for diesel engines are much higher than spark-ignition engines. The average compression ratio is 16 to 1 and varies from as low as 14 to 1 to as high as 20 to 1.

LP GAS

LP gas is all propane or mostly propane because of the high demand for butane in the chemical industry. A good example of LP gas may be stored in a large tank and is used to provide heat to many houses in rural communities. LP gas (as well as butane) is in a gaseous form and cannot be used through a regular gasoline tank and carburetor. It must be stored and handled in high-pressure containers to keep it in liquid form. Machines equipped for LP gas use the vapor in the top of the fuel tank for easy starting because it is already vaporized. The compression ratio is from 8 to 1 to as high as 10 to 1.

ALTERNATIVE ENERGY SOURCES

Agricultural scientists are making efforts to develop alternative energy sources, which are renewable, less polluting, and more dependable.

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Ethanol

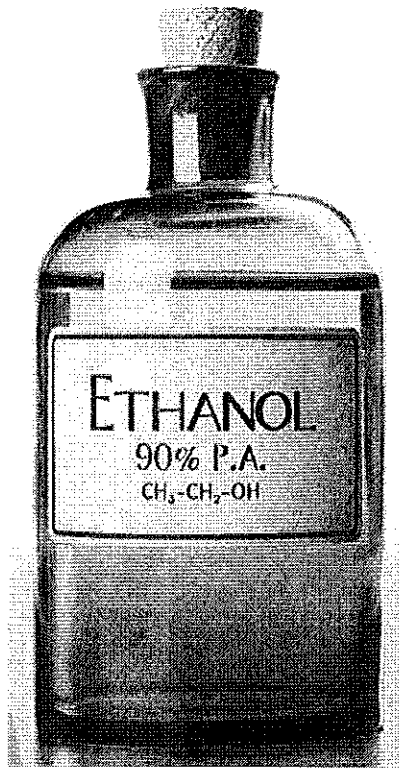

FIGURE 1. Pure, concentrated ethanol.

Ethanol is an important alternative energy source and is one of a large group of substances called alcohols. It is a liquid that can be used as a fuel in its natural form or blended with gasoline. Ethanol is actually a raw material in industrial and technological processes. In addition, ethanol is a product of **fermentation**, which is a process by which many organisms derive energy from sugar. In its neat or pure form, ethanol is colorless, water-like, and a liquid with a mild odor that can be used in specially designed vehicles. The E-10 blend is created when one unit of ethanol is mixed with nine units of gasoline. Then it may be used in vehicles that accept E-10 blend as a fuel source. The **E-85 fuel** is gasoline that contains 85 percent ethanol.

Biodiesel

Biodiesel is a diesel fuel replacement derived from renewable agricultural feed stocks (e.g., soybean oil, animal fats, and other vegetable oils). Dr. Rudolf Diesel, inventor of the diesel engine, was using 100 percent vegetable oil in diesel engines long before petroleum-based diesel fuel was refined. Biodiesel is made through a conventional chemical process called transesterification—a process that makes biodiesel and the byproduct glycerine. Glycerine has several commercial applications from toothpaste to environmentally friendly antifreeze.

Biodiesel is biodegradable and non-toxic. It greatly reduces engine emissions compared to petroleum-based diesel. Biodiesel may be used as 100 percent replacement for standard diesel fuel, or it can be easily mixed with conventional diesel fuel. Power, acceleration, and fuel consumption results are similar to those of petroleum-based diesel fuel. Biodiesel emission is lower than traditional fuels. Biodiesel in its pure form is totally biodegradable, and the flash point is higher than petroleum diesel. As a result, it is safer to handle and store. **Flash point** is the temperature to which fuel must be heated to create a sufficient mixture of fuel vapor and air above the surface of the liquid so ignition will occur when the mixture is exposed to an open flame.

PROPERTIES OF FUELS

It is important to understand the principle qualities that make a fuel satisfactory. Each is unique in its qualities, which determines its satisfactory properties. Most new one-fuel gasoline engines are designed to operate on regular grade leaded or lead-free gasoline. Regular grade leaded or lead-free gasoline, purchased from a reliable dealer, will almost certainly have

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the grade and quality of the fuel needed. There are several important qualities to look for when selecting fuels.

Octane Rating

The **octane rating** is a method of comparing the anti-knock qualities of fuels used in a spark-ignition engine with standard test fuels. Fuels with the least tendency to knock have higher octane numbers, while fuels near the zero end of the scale frequently have a tendency to knock. The names "premium," "regular," and "low grade" are rough comparative measures of octane ratings. Most manufacturers design engines to use regular grade gasoline. Premium grade gasoline can be used, but there is usually no advantage since most engines are not designed for and do not have a high enough compression ratio to benefit from the higher octane rating, which is more expensive.

Volatility

Volatility is the tendency to change from a liquid to vapor or evaporate and is the gasoline property, which is most important in engine starting and performance. If the volatility is too low, insufficient vapor can affect starting. Gasoline with too high a volatility is apt to cause carburetor icing and vapor lock under adverse atmospheric conditions. Oil companies blend their gasoline differently during the year. Higher summer temperatures will allow the engine to start without the gasoline having high volatility. During the winter, an engine will be slow to start unless the gasoline vaporizes readily, so the gasoline is blended for higher volatility.

Oxidative Stability

High oxidation stability and freedom from gum is another quality to consider when selecting gasoline. The **oxidative stability** is the tendency of gasoline to form gum in storage. For example, most gasoline fuels are adequately stabilized by antioxidant additives that minimize gum formation and lead anti-knock decomposition.

Freedom from dirt and moisture is mostly a matter of how gasoline is handled and stored. Additives have become essential ingredients of modern gasoline. Additives are used to raise the octane number and to combat surface ignition, spark plug fouling, gum formation, rust, carburetor icing, deposits in the intake system, and intake valve sticking.

LP Gas Qualities

When selecting LP gas, little can be done except to deal with a reliable distributor. Fuels should be relatively free from sulfur compounds and other contaminants, which may cause difficulties (e.g., filter plugging and valve failures). The refining processes used to produce diesel fuel must be controlled to insure the proper characteristics and to maintain product uniformity.

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Diesel Fuel Qualities

The American Society for Testing Materials (ASTM) has established a classification of diesel fuels for various types of diesel engine service. The major grades are No. 1-D and No. 2-D. Grade No. 1-D diesel fuel is the class of volatile fuel oils from kerosene to the intermediate distillates. These fuels are for use in high-speed engines in services involving frequent and relatively wide variations in loads and speeds as well as where abnormally low fuel temperatures are encountered.

Grade No. 2-D diesel fuel is the class of distillate gas oils of lower volatility. These fuels are for use in high-speed engines in services involving relatively high loads and uniform speeds or in engines not requiring fuels having the higher volatility or other properties specified for Grade No. 1-D.

Ignition Quality of Diesel Fuel

The method for determining the ignition quality of diesel fuel is in terms of a cetane number. The scale of the cetane number represents blends of two pure hydrocarbon reference fuels. The aromatic hydrocarbons have a low cetane number, but the paraffins have a high cetane number. The naphthenes fall somewhere in between. Cetane is a hydrocarbon with high ignition quality that represents the top of the scale with a number of 100. The hydrocarbon called alphamethylnaphthalene has low ignition quality and represents the bottom of the scale with a cetane number of zero. Blends of the two hydrocarbons represent intermediate ignition qualities, and their cetane number is the percentage of cetane in the blend. The desirable cetane number is established by the requirements for good ignition quality during starting and light load operation at low temperatures.

High cetane fuels permit an engine to be started at lower air temperatures, provide faster engine warm-up without misfiring or white smoke, reduce the rate of formation of varnish and carbon deposits, and eliminate combustion roughness or diesel knock. Cetane numbers that are too high may lead to incomplete combustion and exhaust smoke if the ignition delay period is too short to allow proper mixing of the fuel and air within the combustion space.

Distillation Characteristics

The distillation characteristics of a diesel fuel are essential for good combustion in the diesel engine. Volatility characteristics influence the amount and kind of exhaust smoke and odor. The components of the blend, which boil at the highest temperatures, have higher heating values than the lighter fractions. Too many heavy fractions in the final product may improve fuel economy but can be harmful due to deposit formation within the engine. Too many light fractions may provide easier engine starting and more complete combustion under a variety of engine conditions. However, the light ends are generally low in ignition quality and do not release as much energy per gallon as the heavier fractions.

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Pour Point

Diesel fuel must be able to flow at the lowest expected atmospheric temperatures. The **pour point** is the lowest temperature at which fuel ceases to flow.

- As the fuel temperature decreases toward the pour point, the fuel becomes sluggish and harder to pump through the fuel supply lines, fuel filters, and injection system.
- Low pour points can often be obtained only at the expense of a lower cetane number or higher volatility. The pour-point specification should not be any lower than necessary.
- Diesel fuel becomes cloudy and forms wax crystals and other solid substances at some temperature above the pour point. The temperature at which clouding begins is the **cloud point**. The wax crystals clog fuel filters and supply lines. This occurs at temperatures above the pour point, so the cloud point may be even more important in a fuel specification than the pour point.
- Diesel engine injection pumps perform most effectively when the fuel has the proper body or viscosity. **Viscosity** is a measure of resistance of a fluid to flow. Lower viscosities may require more frequent maintenance of injection system parts. High viscosity may cause excessively high pressure in the injection system.
- The gravity of diesel fuel is an index of its density or weight per unit volume. The denser the fuel, the higher its heat content.
- The flash point is the temperature to which the fuel must be heated to create a sufficient mixture of fuel vapor and air above the surface of the liquid so ignition will occur when the mixture is exposed to an open flame.
- The tendency of a diesel fuel to form carbon deposits in an engine may be roughly approximated by determining the carbon residue of the fuel. The **carbon residue** is the amount of material left after evaporation and chemical decomposition of the fuel have taken place at an elevated temperature for a specified period of time.
  - High carbon residue values indicate the possibility of increased combustion chamber deposits and exhaust smoke.
  - Diesel fuels contain varying amounts of sulfur, depending on the crude oil source, refining processes, and grade. Sulfur tends to be more prevalent in the higher boiling range fractions. High sulfur content can become a problem in diesel engine operation at low temperatures and during intermittent engine operation.
- In diesel fuel, the **ash content** is the small amounts of non-burnable material in the form of soluble metallic soaps and abrasive solids.
- Diesel engine injectors are precision-made units of extremely close fits and tolerances. They are sensitive to any abrasive material in the fuel.

STORAGE METHODS

When storing fuels, the fuel type to be stored will determine the storage method. Each state has its own laws regarding the handling, storage, and use of fuels. It is important to become

April 13-17 Choice 2

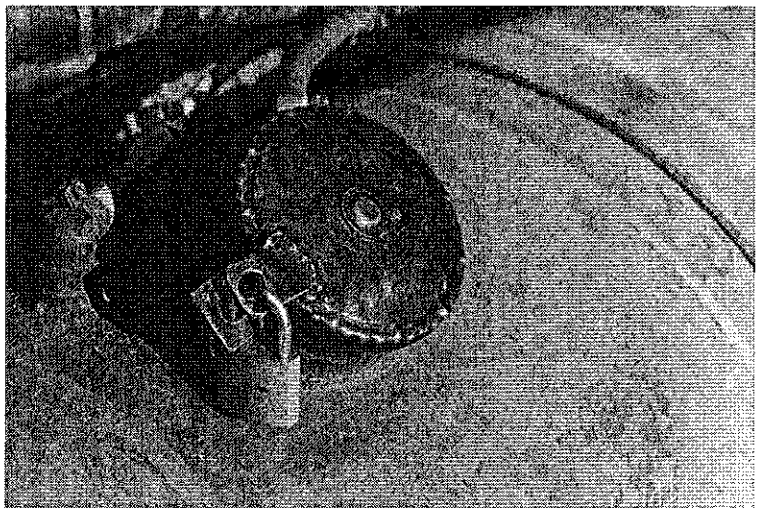

FIGURE 2. This is a fuel storage tank.

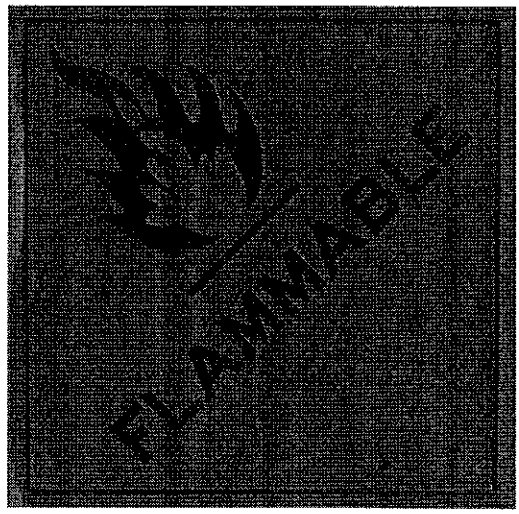

FIGURE 3. Gasoline, diesel fuel, and LP gas are among flammable materials found on most farms and in rural communities.

acquainted with such laws for safety and insurance purposes. State laws are based on the standards and codes established by the National Fire Protection Association. Proper storing and handling of fuels can affect the safety of individuals, how easily the machine starts, and how much maintenance the fuel system requires.

GASOLINE QUALITY

Certain conditions must be controlled to maintain gasoline quality. Evaporation losses are sizable from an aboveground tank unless provisions exist for shading it. Evaporation losses can be further reduced by the use of a pressure-vacuum release vent. Before using one of these valves, check with the state fire marshal for approval.

AGE OF GASOLINE

Gasoline will oxidize and form gum deposits if kept for long periods. Refiners of gasoline add an inhibitor to protect the fuel for six months to a year under normal storage conditions, but the time is greatly reduced if the gasoline is exposed to sunlight and to high storage temperatures. It is important to protect against water and dirt in the storage tank. The more the temperature of a storage tank varies, the more air it breathes in and out. The fresh warm air breathed in may contain more moisture than it can hold when the temperature drops. This causes moisture to condense on the inside of the tank and collect at the bottom under the fuel. The water must be drained or pumped out occasionally to avoid freezing, rusting, and clogging of the carburetor.

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LP GAS

At ordinary temperatures, LP changes to a gas, unless it is kept under pressure. LP gas must be stored in pressure-type tanks. There is no problem protecting fuel quality. There is virtually no evaporation from the pressure tank, nor does the fuel change chemically during storage. Since LP gas is kept under pressure and is highly flammable, rigid standards have been established.

FREE OF DIRT AND WATER

Keeping the fuel free of dirt and water is important with diesel fuel. The fuel injection system on a diesel engine is fitted with parts held within millionths of an inch clearance. Very fine dirt particles can ruin the parts and result in expensive repair jobs. Water—about the same weight as diesel fuel—settles out slowly, which can cause corrosion that ruins the highly polished surfaces of the injector nozzle. Allow 24 hours for water and dirt to settle to the bottom of the storage tank after it has been refilled. Do not let water collect on top of the fuel storage tank because water retained on the tank tends to rust the outside as fuel is drawn from the tank. Water may be drawn through the air vent directly into the fuel supply.

PREVENTING DIRT FROM ENTERING FUEL SUPPLY

Do not use an open container to transfer fuel from the storage tank to the machine tank. Also, diesel fuel should not be stored in a galvanized tank. Galvanized is fine for gasoline, but diesel fuel reacts with the galvanized finish causing powdery particles to form. A tank formerly used for gasoline storage should not be used. Fine dust and dirt particles that settle out of the gasoline and accumulate on the bottom of the tank mix with diesel and may remain suspended in it until drawn from the tank. Do not let the suction pipe of the fuel pump extend to the bottom of the storage tank. The end of the pipe must be 3 to 4 inches from the bottom. If possible, the tank should be sloped away from the pipe or outlet valve. The storage tank should always be drained before refilling it, and it should be cleaned regularly. To keep gum and varnish tendencies from occurring, shade the storage tank from direct sunlight.

SAFETY PRACTICES

Safety practices must be in place and utilized when working with or around fuels of all types in agricultural settings. Accidents may occur in the handling, use, and storage of gasoline, diesel fuel, and LP gas and can result in serious fires and explosions. The chances of fire or explosion can be reduced by following safety precautions and by keeping fuel storage facilities in top condition.

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Flammable Materials

Gasoline, diesel fuel, and LP gas are among flammable materials found on most farms and in rural communities. It is imperative that these liquids be kept away from open flames and motors that might spark.

Out of Reach of Children

All petroleum storage and handling equipment should be kept in good condition and out of reach of children. A plan should be made to inspect often for leaks, deterioration, and/or damage. Fuel should never be stored in food or drink containers.

Containers

When transferring farm fuels, the containers should be bonded to each other. Ground the one being dispensed from to prevent sparks from static electricity. Spills should be cleaned up immediately, and place oily rags in a tightly covered metal container. If working around these fuels, change your clothes immediately if fuel is splashed or spilled on them.

Transportation

Gasoline should not be kept inside the home or transported in the trunks of automobiles or recreation vehicles. Gasoline cans or approved containers should be placed in a dry and cool location.

Reduce Accidents

Proper storage and use of flammable liquids (e.g., fuels) can significantly reduce the possibility of accidental fires and injuries to those who work near them. To minimize the risk to life and property, the requirements of the National Fire Protection Agency (NFPA) as well as the Occupational Safety and Health Administration (OSHA) have implemented safety standards to follow at all times when working around fuels. Fuels are flammable and combustible liquids and require careful handling. The proper storage of fuels within a work area is important to protect people from fire and other safety and health hazards. Fuels stored in bulk drums must be grounded and bonded to containers during dispensing.

Portable containers of gasoline or diesel fuel are not to exceed five gallons. Appropriate fire extinguishers are to be mounted within 75 feet of outside areas containing flammable liquids and within 10 feet of any inside storage area for such materials. Storage rooms or areas for housing fuels must have explosion-proof light fixtures. Bulk storage of gasoline or diesel fuels must be kept in above-ground tanks. Tank areas should be diked to contain accidental spills. Tanks shall be labeled according to the NFPA guidelines. All tank areas shall be designated no smoking, no hot work, and no open flame areas.

Alert and Cautious

Be alert and cautious during refueling. Fires and explosions can happen immediately if spills occur. Besides being a fire hazard, spilled fuel can cause irritation and discomfort if it contacts the skin. Breathing an excess of fuel vapor often causes dizziness and headaches.

When arriving to refuel, drive slowly to the fuel pump or storage tank, being careful not to bump it. Turn off the engine, and extinguish smoking materials. If the engine is hot, allow it to cool for a few minutes. Position yourself so refueling occurs without slipping or becoming fatigued. Remove the fuel cap slowly, and allow the pressure to dissipate.

Avoid over filling. After releasing the nozzle valve to shut off fuel flow, the nozzle should be kept in the filler opening a few moments to allow it to empty. Check vents to be sure they are not clogged, and replace the filler cap. Then lock the pumps so children and other unauthorized people cannot pump fuel. Small equipment always should be refueled outside—never in an enclosed area. A funnel will make the job easier when using a safety can. Wipe up spills. Allow the excess to evaporate before starting the engine. Before resuming work, return the safety can to storage.

Above-Ground Storage

Using an above-ground storage facility is cost effective for storing fuels. The tanks are movable. Ground water or limited flooding has little effect on the tanks. Above-ground storage tanks must be sturdy and designed for fuel storage. They should be 40 feet or more from buildings. A tank too near a burning building could explode and spread the fire. A tank elevated for gravity discharge should be mounted on sturdy supports placed on a firm, level surface. Keep the area clear of weeds and trash to reduce fire risk. Remind machinery operators to stay away from the support structure and to not bump it when pulling up to refuel. Unless tanks are located in a shaded spot or have overhead canopies to shield the sun, evaporation losses can be sizable. Use a pressure-vacuum relief valve (rather than the standard vented cap) so pressure may be released slowly.

Labeled Safety Containers

A labeled safety container is made of heavy-gauge metal and has a cap that automatically closes to prevent a spill if the can is dropped or tipped over. The squat shape makes a safety can difficult to tip. A pressure-relief valve opens when vapor pressure inside the can reaches three to five pounds per square inch. A flash-arresting screen in the filler opening and pouring spout will reduce the possibility of a spark that could cause a fire or explosion. Label fuel containers according to their contents to prevent the risk of confusing diesel fuel and gasoline. Paint gasoline cans red and diesel cans green. Store cans in a cool, well-ventilated place, away from living quarters and ignition sources.

Fire or Explosion Hazard

The fire or explosion hazard with LP gas usually involves leaks or failures in the system, improper transfer of liquid from one tank to another, or accidents where tanks or lines are rup-

tured. Also, an LP tank involved in a building, trash, or tractor fire can greatly intensify such a fire or even explode.

LP Storage Tanks

Large LP storage tanks should be at least 50 feet from the nearest building and 20 or more feet from other above-ground fuel tanks. It is essential to provide and maintain solid foundations to support LP gas tanks so they will not settle, tip and break, or damage connections. The storage tank should be equipped with a liquid-fill hose and a vapor-return hose. If the vapor escapes into the atmosphere, a fire or explosive danger is created. Therefore, when a fuel tank is filled, the vapor from the top should be fed back into the storage tank.

Be alert and cautious for leaks in the LP gas system. Protect gauges and regulators from weather and dirt. If a gas odor is present, turn off the valve(s) at the tank(s). Open windows and doors to ventilate the building. Nothing electrical should be switched on. Evacuate everyone from the area, and call a technician to find and fix the leak.

Good Condition

Keep all equipment used for petroleum storage and handling in good condition. Always check for leaks, deterioration, and/or damage. Make needed repairs, or replace faulty components immediately. Keep cap vents clean. In addition, tank and safety can pressure-relief valves should be functional. If fuel is spilled on clothing, go outside—away from any ignition source—and allow the clothing to dry. If more than a little was spilled, remove the garment, and wash the fuel from the skin to avoid irritation.

When siphoning fuel, use a pump. Never put the connection in your mouth or mouth area. A mouthful of gasoline or diesel fuel could be fatal, especially if it enters your lungs. Also, avoid excessive inhalation of gasoline vapor. When servicing machinery, check the fuel system for leaks. Double-check connections to ensure they are secure and leak-free after changing fuel filters or performing other work requiring disconnecting or removing a fuel line or fuel-system component. Turn off oil heaters before refueling. Replace and tighten the filler cap. Set

UNDER INVESTIGATION...

LAB CONNECTION: Can I Make My Own Ethanol?

If ethanol is produced on a small scale, it can be made from grain you have grown or from a wide range of other local and sustainable feed stocks, including food waste and crop culls. With a little specialized equipment and know-how, you can turn these materials into alcohol fuel, and it will cost less than you would pay at the pump for gasoline or commercially produced ethanol.

You can produce your own ethanol for an ongoing cost of less than $2 per gallon. If you grow your own corn, you can distill more than 300 gallons of ethanol from 1 acre of corn. If you drive less than 10,000 miles per year, you could produce all your own fuel from 2 acres of corn. In short, ethanol can be made on your farm using your grain. Conduct online research regarding the steps you would need to take to accomplish this goal.

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portable heaters away from combustibles where they cannot be tipped over. Motor oil and grease are considerably less flammable than engine fuels, but they will burn. Therefore, they should be kept away from ignition sources.

Containers

Gasoline containers are dangerous. They contain a flammable substance that can ignite and burn easily. As a result, use extreme care in handling and storing these containers. Hydrocarbons (gasoline) build up static electricity as they are stirred or agitated during refilling. Always refill gas cans while they are in contact with the ground and never while in the trunk of a car or in the bed of a truck. Those charged particles are looking for a place to discharge their stored energy and cannot do so safely because the plastic container or a truck bed liner act as an insulator.

Always dispense gasoline into an approved container (preferably metal) designed and labeled for gasoline storage and transportation. If in a pinch, use an approved plastic container designed and labeled for the storage and transport of gasoline. Bleach jugs or glass jars should never be used to carry gasoline. Gasoline or diesel engines should only be refueled after they are cool.

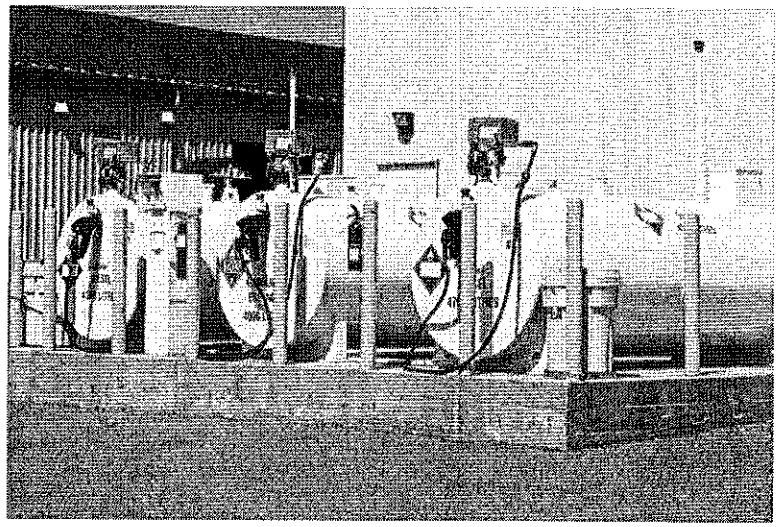

FIGURE 4. Environmentally safe fuel tanks with fire extinguishers.

INTERNAL COMBUSTION ENGINES

All internal combustion engines need certain items to operate effectively. They are air, fuel, and a spark (if they are gas engines). The fuel system is critical in storing and delivering the gasoline or diesel fuel in the engine for it to operate properly. A good analogy of the engine is that of the human vascular system with a heart (fuel pump), veins (fuel lines), and kidneys (filter). A failure in any of these fuel-system components has the same devastating effects as it does for humans.

Holding Tank

The major function of the fuel tank is to serve as a holding tank for fuel. When gasoline is pumped into the gas line at a gas station, the gas travels down the filler tube and into the tank. In the tank, there is a sending unit, which tells the gas gauge how much gas is in the tank. In

recent years, the gas tank has become a little more complicated, as it now often houses the fuel pump and has more emission controls to prevent vapors from leaking into the air.

Fuel Pump

The fuel pump is an essential part as well. On newer cars, the fuel pump is usually installed in the fuel tank. Older cars have the fuel pump attached to the engine or on the frame rail between the tank and the engine. If the pump is in the tank or on the frame rail, it is electric and is run by a car's battery. Fuel pumps mounted to the engine use engine motion to pump the fuel, most often being driven by the camshaft, but sometimes by the crankshaft.

Fuel Filter

The fuel filter is needed to keep dirt and debris out of the fuel. Clean fuel is critical to engine life and performance. Fuel injectors and carburetors have tiny openings, which clog easily. Therefore, filtering the fuel is a necessity. Filters can be before or after the fuel pump. In some engines, it is in both locations. They are most often made from a paper element, but they can be stainless steel or synthetic material and are designed to be disposable in most cases. Some performance fuel filters have washable mesh, which eliminates the need for replacement.

Fuel Injectors

The fuel injectors allow fuel into the engine. Most domestic cars produced after 1986 (and earlier foreign cars) came from the factory with fuel injection. Instead of a carburetor to mix the fuel and air, a computer controls when the fuel injectors open to let fuel into the engine for lower emissions and better fuel economy. The fuel injectors are basically tiny electric valves that open and close with an electric signal. By injecting the fuel close to the cylinder heads, the fuel stays atomized (in tiny particles) so it will burn better when ignited by the spark plugs.

Carburetor

The carburetor in the engine takes the fuel and mixes it with air without computer intervention. While simple in operation, a carburetor tends to need frequent tuning and rebuilding. As a result, most cars produced within the past 10 years have done away with carburetors in favor of fuel-injection systems.

GUIDELINES

Follow the manufacturer's recommendations found in the operator's manual when performing service or maintenance on the fuel system.

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Maximum Fuel Economy

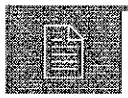
To achieve maximum fuel economy and horsepower, periodic service must be performed to keep the fuel system operating correctly. If this is done on a regular basis, the fuel efficiency of the engine will be maintained. If the carburetor is not adjusted correctly, fuel consumption can be excessive or power can be lost. Clean the strainer regularly, and change the fuel filter at regular intervals.

Diesel Fuel System

The diesel fuel system requires careful service to keep it operating properly. Servicing the injection pump and injector nozzles requires special tools and equipment. The dealer or service center should perform all adjustments and repair of precision injection units. The other components on the low-pressure side, fuel filters, sediment bowl, and tank should be carefully monitored. Use the operating manual as a guide for filter change intervals and recommendations.

Each time the fuel lines or filters are drained or changed, air remains in them and may form an air lock, which will prevent the normal supply of fuel reaching the injection pump. As a result, the engine may not start or may run poorly. The air must be bled off before you attempt to start the engine.

Summary:



The fuels used in agriculture come from fossil fuels from long ago and are still being used. These fuels include gasoline, diesel fuel, and LP gas. Each is used in unique ways in the agriculture field as well in everyday life. Ethanol and biofuels are becoming prominent at the gas stations and are consistently being researched to produce the best gas ratings produced. In addition, with all of these fuels, safety practices must be followed. Fuels are highly flammable, so keeping safety precautions intact as well as being alert and assertive around fuels is essential.

Checking Your Knowledge:

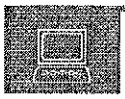
1. What are the various types of fuel used in agriculture?
2. What is ethanol, and how is it produced?
3. What are biofuels, and how are they produced?
4. What are the best safety practices to follow when working with fuels?
5. How are fuels used in the agricultural economy?

Choice 2

Expanding Your Knowledge:

Conduct an investigation as to how ethanol and biofuels are made. Prepare a list of the steps in making these fuels and what the ingredients are for making them. Interview a farmer that sells his or her grain for ethanol and/or biofuels. Compare the various fuels, such as gasoline and diesel fuel to ethanol. How do they differ? How do their octane ratings differ? Why can't all engines just use ethanol so there is a source for corn produced other than food processing? Investigate these questions, and provide your opinions as to how you might address these. Write all of this in your agriculture notes, and share it with your class.

Web Links:



Asia's Biofuel Sector Set to Grow

https://www.edb.gov.sg/content/edb/en/news-and-events/news/singapore-business-news/Feature/asia-biofuel-sector-set-to-grow.html

Biofuel Basics

http://www.nrel.gov/learning/re_biofuels.html

Ethanol

https://www.fueleconomy.gov/feg/ethanol.shtml

Types of Fossil Fuels

https://blog.udemy.com/types-of-fossil-fuels/

Choice 2

Ag Meh Mr. Coon April 13 Name

Checking Your Knowledge:

1. What are the various types of fuel used in agriculture?

2. What is ethanol, and how is it produced?

3. What are biofuels, and how are they produced?

4. What are the best safety practices to follow when working with fuels?

5. How are fuels used in the agricultural economy?

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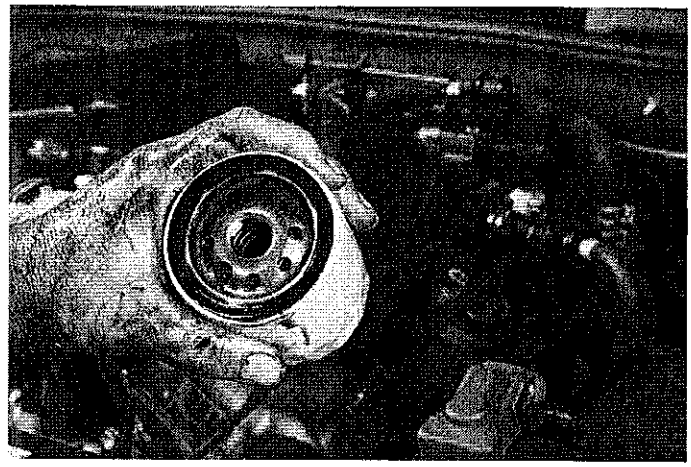
Lubricants

THE ENGINE LUBRICATION SYSTEM is designed to deliver clean oil at the correct temperature and pressure to every engine part. Engine oil is sucked in and out of a pump, which is the "heart" of its system. Lubricants protect engine parts and provide them with an oil film to keep them lubricated. If there is a lack of oil in the engine, for example, the parts become dry and do not operate or move properly. Several types of lubricants exist, with specific purposes used in agricultural equipment.



Objective:

List and describe the various facets and practices when working with or around lubricants in agriculture.

Key Terms:

American Petroleum Institute (API)
bypass system
contaminants
dispersants
hydraulic fluids
multi-grade
multi-viscosity
oxidation inhibitors
polymers
viscosity

Understanding Lubricants Used in Agriculture

The engine lubrication system is designed to deliver clean oil at the correct temperature and pressure to every engine part. Engine oil is sucked in and out of a pump, which is the "heart" of the engine's system. Several types of lubricants exist, with specific purposes used in agricultural equipment. A lot of work has been put into the refining of oil to make it work in various

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types of engines and machines. Thus, special oils have been developed for each engine type, for each machine type, and for each season.

OIL CLASSIFICATIONS

Several oil classifications exist. The Society of Automotive Engineers (SAE) is a group responsible for establishing the oil viscosity. The **American Petroleum Institute (API)** is a group that provides the service classification of the oil being produced. MIL represents specification prepared by the Ordinance Department of the U.S. Army, Navy, and Air Force. The American Society for Testing Materials (ASTM) conducts the engine sequence tests, which are testing procedures on the oil.

VISCOSITY

Viscosity (thickness) is a measure of the fluidity of oil at a given temperature. Oils vary in viscosity with temperature changes, becoming more fluid as temperatures increase and less fluid as temperatures decrease. The lighter or more fluid oils are intended for winter use. All W-grade oils are specifically tested under cold conditions to assure cold temperature performance. **Multi-grade** are oil types compounded to behave as light oils at cold temperatures and as heavier oils at high temperatures. **Multi-viscosity** is another term for multi-grade when referring to oil types. One multi-viscosity oil can replace as many as four or five single-grade oils and can give protection at high and low temperatures. These oil types have become popular in agricultural machines because of their ability to withstand high and low temperatures.

Polymers

Multi-grade oils are formulated with **polymers**, which are products added to the base oil (of the lower viscosity grade) to determine the best viscosity for that specific oil type. The polymers do not significantly affect low temperature viscosity; they expand with increasing temperatures, causing an increase in viscosity. Lower viscosity can lead to easier starting and improved fuel economy during warm up. Higher viscosity at high temperatures controls oil consumption as well or better than the corresponding single grade.

Diesel Engine Oil

Oil requirements for diesel engines differ substantially from those for gasoline engines primarily due to the operating temperatures and conditions of use.

Additives

Additives that perform acceptably in one engine type may not perform to the same degree in another engine type.

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Contaminants in Oil

Contaminants seriously hamper good lubrication, regardless of the oil's original quality. Contaminants are items such as dirt, dust, pieces of leaves, branches, and insects, for example. Dust, which is considered an external contaminant, is taken in with the combustion air. Similar material also enters the engine crankcase by the breathing action taking place in that area. In diesel engines, fuel soot particles from combustion enter the crankcase oil with blow by gases. Microscopic metal particles also get into the oil as a result of normal engine wear. As foreign particles accumulate, increased wear soon results in the cylinder bore, on piston rings, and within bearings, even though the best oil was used originally. Restricted oil flow and in combination with water and oxidized products form sludge.

Sulfur

The sulfur content of diesel fuel is problematic. Diesel engine oils must help protect against the formation of sulfuric acid, which causes corrosion.

CONTAMINANTS

Contaminants are items that seriously hamper good lubrication, regardless of the oil's original quality (e.g., dirt; dust; and pieces of leaves, branches, and insects).

Dust

Dust—considered an external contaminant—is taken in with the combustion air. Similar material enters the engine crankcase by the breathing action taking place in that area.

Fuel Soot Particles

In diesel engines, fuel soot particles from combustion enter the crankcase oil with blow by gases.

Microscopic Metal Particles

Microscopic metal particles also enter the oil as a result of normal engine wear. As foreign particles accumulate, increased wear soon results in the cylinder bore, on piston rings, and within bearings, even though the best oil was used originally. Restricted oil flow—in combination with water and oxidized products—forms sludge. Oil companies have helped in the fight against contaminants by introducing additives in the oil. Special oil additives are put into lubricating oils to provide the extra performance required of high-speed engines.

Additives

- Anti-scuff additives reduce the number of metal particles resulting from engine wear.

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- Anti-corrosion additives prevent failure of alloy bearings from corrosive acids formed as a normal byproduct of combustion.
- Anti-rust additives prevent rusting of metal parts during storage periods, down time, and even overnight. The additives also neutralize acids so they are no longer harmful. They cling to metal surfaces, which builds up a protective coating that repels water droplets and protects metal from rust. In addition, the use of detergents reduces deposit build-up.
- **Dispersants** are agents that keep contaminants finely dispersed in the oil. With dispersants present, there is no interfering with the lubricating oil qualities.
- **Oxidation inhibitors** are products used to keep oil from oxidizing at high temperatures and to prevent acids, varnish, and sludge formation.
- The viscosity index improver helps an oil give top lubricating protection at low and high temperatures.
- Pour-point depressant additives prevent wax crystals from forming clumps in cold weather.
- Extreme pressure additives assure lubrication where extreme pressures between close tolerance and metal-to-metal surfaces are encountered.
- Foam inhibitor additive prevents air bubbles, which would otherwise restrict lubrication.

GEAR OILS

Gear oils are used in enclosed gearboxes to lubricate mechanical transmissions, differentials, and steering gears. To perform satisfactorily under modern conditions, most gear oils should have several properties. Extreme pressure properties are required in gear systems where hypoid, heavily loaded spiral-bevel, and worm gear combinations are used. Gear lubricants must be chemically stable to resist oxidation and sludge formation under sustained heat, with violent agitation and air foaming.

FLUIDS

Fluids for automatic transmissions, torque converters, hydraulic systems, and transmission-hydraulic units have different responsibilities. Automatic transmission fluid serves several jobs, including the following:

- Protecting heavily loaded helical and spiral gears with an oil film
- Performing as a non-foaming fluid in transmitting power
- Operating as a hydraulic fluid between –30 and 300 degrees
- Acting as a wet clutch and transmission lubricant to provide smooth, silent engagement, without slipping
- Resisting oxidation under conditions of heat and aeration, while at the same time being compatible to all metals, rubber seals, gaskets, adhesives, facings, and liners in the system

April 13-17 Choice 3

COMMON RESERVOIR

A number of farm and industrial manufacturers have designed machines with a common reservoir for the transmission and hydraulic systems.

- The same lubricating fluid may have to serve the gear train, differential, hydraulic clutches, and disk brakes as well as the hydraulic system and power systems. The primary function of hydraulic fluid is to transmit power.
- The fluid must be stable over long periods. In addition, it must protect the machine against rust and corrosion while acting as a lubricant and heat absorber. The fluid must be readily available and economical.
- Viscosity is the most important property of a hydraulic fluid. Viscosity oils that are too low can cause leakage, while viscosity that is too high can cause sluggish operation, heating, and high pressure.
- **Hydraulic fluids** are substances subject to heat, agitation, and aeration, which are ideal conditions for oxidation and deterioration. In well-kept systems with little fluid loss and oils in service for long periods, oxidation inhibitors are necessary.
- Rusting and acid are the two types of corrosion found in hydraulic systems. A potent rust inhibitor is necessary for hydraulic systems because the system is vented, and it is impossible to prevent reservoir breathing and taking in moisture and condensation that cause rusting.
- Oil coolers can eliminate conditions for oxidation of oil products, which result in acid corrosion.
- Pour point is of prime importance to mobile and outdoor equipment. Winter temperatures fall far below the natural pour point of most oils, so the oil must be fortified with pour point depressants to allow it to flow at sub-zero temperatures.
- Foaming in hydraulic fluids can be caused by excessive agitation in the presence of air, by air leaking into the system, or by contaminants (e.g., dirt and water).
- Most hydraulic fluids contain a small amount of silicone material that does not prevent foaming but causes the foam to be unstable and break down rapidly.
- Hydraulic pumps are extremely susceptible to wear. Manufacturers recommend oils that contain anti-wear compounds. Seals in the hydraulic system contain rubber and other materials, which could deteriorate if oil contains harmful materials.

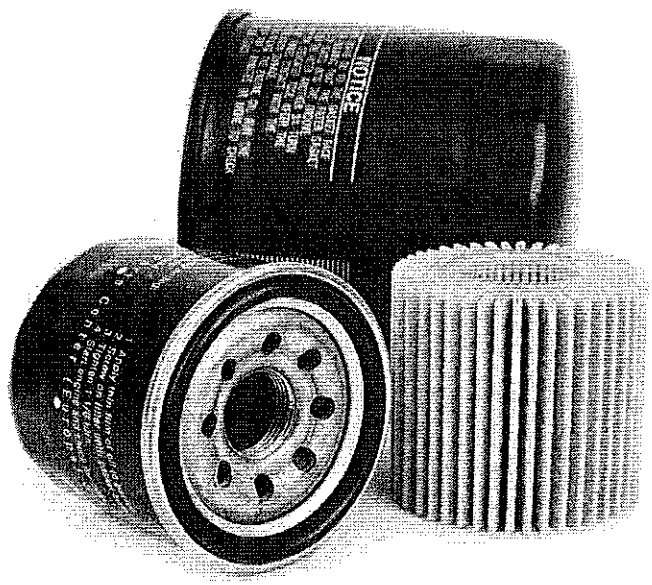

FIGURE 1. Oil filters are used in engines.

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SELECTION, STORAGE, AND SAFE HANDLING

Just as in carefully selecting and storing fuel in a safe and secure location, lubricants must be selected carefully, used for the proper task, and stored properly. Consult the operator's manual for the engine being lubricated, especially when selecting and storing lubricants. Follow the guidelines carefully and always use lubricating agents in the proper manner.

Proper Care

Machine operators can help prevent early mechanical failure through proper care of the air filter elements, oil filler breather cap, and crankcase ventilator as well as regular and frequent oil and oil filter changes. In addition, proper storage and handling of lubricants is necessary.

When selecting oil, the correct weight (specified for the engine in being serviced) must be selected. When adding or changing oil, the correct service classification must be used. Lubricants should be stored in clean, closed cabinets or rooms. Covers and pour spouts on the drums or containers should be kept closed when not in use to keep out impurities and reduce condensation of water caused by atmospheric changes. Oil containers and funnels should be cleaned with a dry shop rag. They should be covered to keep out dirt, or they can be stored upside down. When adding oil, all dirt should be cleaned from around the filler cap before removing it. The same thing should be done before unscrewing an oil filter or filter cap.

Hydraulic System Oil

The oil in a hydraulic system serves as the power transmission medium, system lubricant, and coolant. Selection of the proper oil is a requirement for satisfactory system performance and life. Oil must be selected with care and from a reputable supplier. When selecting hydraulic fluids, check the recommendations in the operator's manual. The manufacturer has selected a fluid that meets all the needs of its system, which may vary from simple cylinders to precision hydraulic pumps. Use the same care and precautions in the storing and handling of transmission and hydraulic oils as recommended for engine oils. It is important to prevent the entrance of dirt or moisture into the oil. A little dirt—mixed with oil—makes an excellent grinding compound.

Grease

When using grease as a lubricant, the proper grease for the application must be selected, and generally accepted practices must be followed. The grease containers must be kept in a dust-free place; the grease gun must be wiped off before filling it; and the grease gun must be filled without exposing the grease to dust and dirt. Grease fittings should always be wiped off before applying grease. Dirt should not be forced into a bearing. Excess grease should be wiped off after greasing.

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FUNCTIONS OF LUBRICANTS

Engine oils keep a protective film on moving parts to resist corrosion and rusting. In addition, oil reduces friction and wear caused by metal-to-metal contact of moving parts. If oil is not checked and is then changed or added to the engine as necessary, the engine will not operate properly. As a result, damage may occur to the engine parts.

Viscosity

To prevent metal-to-metal contact, the oil must maintain enough viscosity or thickness to provide a film or cushion between the moving parts under all operating temperatures. In spite of high heat, the viscosity must be no higher than necessary to give good starting and to provide the least friction under sustained running.

Wear and Tear

Wear and tear of engine parts also results from acid corrosion, from rusting, and from the abrasion of contaminants. Therefore, debris in the lubrication system may cause damage or problems to the moving parts.

Cooling Moving Parts

The purpose of engine oil is to cool moving parts. Piston cooling is done by direct heat transfer through the oil film and then to the cylinder walls and on to the cooling system by carrying heat from the underside of the piston crown and skirt to the engine crankcase.

Heat Stability

Oils of equal viscosities have the same heat conductivity, but the oil must have enough heat stability to resist decomposition when in contact with these surfaces. Engine oil helps the pis-

UNDER INVESTIGATION...

LAB CONNECTION: How Is Engine Oil Made or Refined?

Have you ever wondered how engine oil is made? Engine lubricants begin with a base product, which is crude oil (also used to make gasoline and diesel fuel). With synthetic oil, the base product is often a mix of crude oil and a chemically synthesized mix of other non-petroleum elements that offer better viscosity performance. The base product must be refined, which consists of separating unwanted chemicals, particles, and tars in the crude oil. Then the crude oil is heated. Diesel and gasoline come from the mix first. To get the oil, the refining is done further with clay, which is a substance consisting of small, pebble-like rocks that absorb minerals and filter out the clean motor oil. The final product must go through a purification process and then can be sold in a liquid state.

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ton rings seal the high pressures of combustion by forming an oil film on the piston and cylinder walls.

Cleanliness

Also, oil keeps engine parts clean. The oil must prevent the formation of contaminants, which are primarily unburned or partially unburned fuel. However, corrosive acids and water are frequently present. If not prevented, oil must keep contaminants in suspension so they do not settle inside the engine.

THE LUBRICATION SYSTEM

The lubrication system must be serviced and maintained regularly to prevent premature wear and equipment damage. This consists of checking the oil levels daily and changing the oil and filter at the proper intervals.

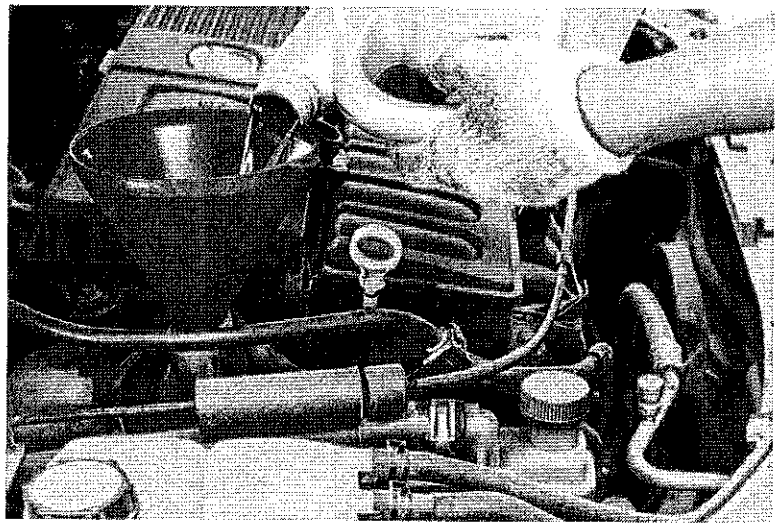

FIGURE 2. Changing oil in a car engine.

Oil Contamination

Oil contamination reduces engine life more than any other factor. Oil loses its good lubricating qualities as it becomes dirty, and its additives wear out.

Oil Filters

Oil filters are designed in all modern engine lubrication systems to combat oil contamination. Filters are classified as surface-type or depth-type depending on the way the oil moves through them.

Surface filters have a single surface that catches and removes dirt particles larger than the holes in the filters. Depth filters use a large volume of filter material to make the oil move in various directions before it finally enters the lubricating system.

Two types of filters are used. The **bypass system** is an assemblage in which a portion of the oil moves through the filter as it leaves the pump. The rest goes directly to the engine bearings. As the filter becomes contaminated, less of the oil goes through and more goes around. In the full-flow system, all of the oil moves through the filter, unless it is partly or completely blocked because of a dirty filter or cold oil. Oil pressure builds up in the filter until the bypass valve is forced open, permitting unfiltered oil to flow around the filter and directly to the engine bearings.

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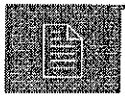
Oil Cooler

Lubrication systems on many engines use an oil cooler to remove heat created by the engine. Most coolers are the oil-to-water cooling type, using engine coolant to dissipate unwanted heat from the engine crankcase.

Summary:



The lubricants used in agriculture come from refined and purified crude oil. Lubricants used in agriculture equipment include engine oils to lubricate engine cavity parts, hydraulics, and gears. Grease is often used to keep specific engine parts lubricated.

Oil is the most common lubricant and must be filtered to be kept clean. The primary function of oil is to protect parts by keeping a film on them; the film is necessary for movement. Keeping the oil clean is a necessity. If the oil becomes contaminated, it can cause a lot of harm to engine parts. Servicing engines to keep lubricants working properly is a must and will keep the engine running smoother and longer.

Checking Your Knowledge:

1. What are the various types of lubricants used in agriculture?
2. What are contaminants that can get into oil?
3. What is the proper way to keep oil clean and pure?
4. What are the best storage practices to follow for lubricants?
5. What are oil classifications used today in agricultural machines/engines?

Expanding Your Knowledge:

Conduct an investigation as to how oil is made from crude oil. Prepare a list of the steps in making engine oil and the ingredients. Where does the oil come from, and how is it refined and purified? Research these questions. If there is a local oil refinery, interview an employee who works with oils and lubricants to find out the procedures and practices. Prepare a poster or a concept map that illustrates the steps in making engine oil from crude oil. In addition, write all of this in your agriculture notes to share with your class.

Choice 3

Web Links:

Engine Lubrication Basics

http://www.machinerylubrication.com/Read/28819/engine-lubrication

Engine Oil and Natural Gas

https://www.youtube.com/watch?v=2_UmgP_yJcw

Change Your Car's Oil

http://www.thecarconnection.com/tips-article/1000815_the-do-it-yourself-oil-change

The Engine Oil Bible

http://www.carbibles.com/engineoil_bible.html

Choice3

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Checking Your Knowledge:

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