LEAKING UNDERGROUND

STORAGE TANKS

9-12

SUBJECTS:
Science (Physical Science, Environmental Science), Social Studies (Economics), Math
TIME:
2 class periods
MATERIALS:
2 sheets of graph of bookkeeping paper per student group calculators (optional)

OBJECTIVES

The student will do the following:

1. Define USTs.

2. List existing environmental hazards caused by USTs.

3. Explain how problems with USTs are remediated.

4. Understand some of the costs associated with UST remediation.

BACKGROUND INFORMATION

Underground Storage Tanks, or USTs, are basically storage tanks placed underground. Throughout the world, the petroleum industry uses most of the USTs. Local gasoline

stations use, by far, the largest number of USTs. Most of them have two to four 4,000 to 12,000 gallon tanks underground. Some rural homeowners may also use USTs for residential or farming purposes.

Problems with USTs arise when they begin to leak. Motor fuel contains hydrocarbons and additives that pose health risks to people, animals, and plants. Nature can break down these hydrocarbons through a method called bioremediation. Unfortunately, nature's work is slow compared to our needs. These dangerous compounds may transmit quickly through soil and can find their way down to an aquifer.

Nationally 51% of the U.S. population relies to some extent on groundwater as a source of drinking water. Aquifers are where these drinking water sources are stored underground. When aquifers become contaminated by hazardous chemicals, the effects can be devastating. Even if people, plants, and animals do not become ill or die, contamination may persist for years; remediation may cost millions of dollars.

Previous common practice was to place unprotected steel USTs and piping in the ground and forget about them. Unprotected steel can be highly subject to corrosion, though, especially in aqueous environments. In 1994, it was estimated that 1.2 million USTs existed in the U.S., many of which could be leaking or leak at some time in the future. Now, new tanks (and related piping) are required to meet federal and state requirements intended to prevent leakage to groundwater. Tanks which do not meet these requirements must be removed, replaced or upgraded by 1998.

Awareness of the problem and new environmental regulations have prompted companies to provide products that will increase UST safety. Liners, double-walled tanks and piping, or fiberglass tanks can be used in UST systems. Sound older, unprotected steel tanks and piping can be upgraded with corrosion protection systems.

Today tank owners are federally required to demonstrate financial responsibility, that is, the availability of funds to clean up a leak or spill should one occur from a tank or line. Most states have established trust funds, paid for by motor fuel sales taxes, to satisfy this requirement. Many states and the federal government are encouraging the insurance industry to take over this job allowing the states to retire their funds.

Federal, state, and sometimes local, governments regulate USTs. They ensure that owners and operators of USTs meet various requirements. Regulatory inspections may cover a variety of procedures that owners and operators must follow. Some of these are listed below.

Owners/operators of USTs must:

1. Register all active UST systems with the appropriate agency.

2. Meet leak detection requirements for both tanks and piping by choosing an appropriate method, depending on size and type of tank system (Figure 2).

3. Install corrosion protection and spill overfill equipment on existing systems no later than December 22, 1998.

Terms

aquifer:
porous, water-bearing layer of sand, gravel, and rock below the Earth's surface; reservoir for groundwater

bioremediation:
a biologically mediated corrective process that occurs naturally over time; humans may speed up this process through technology (see in-situ bioremediation)

corrosion:
a substance formed or an action of wearing away by chemicals; formed by deterioration

groundwater:
water that infiltrates into the Earth and is stored in usable amounts in the soil and rock below the Earth's surface; water within the zone of saturation

hydrocarbons:
a very large group of chemical compounds consisting primarily of carbon and hydrogen. The largest source of hydrocarbons is petroleum (crude oil).

inspect:
to examine in detail, especially for flaws

inventory:
a detailed list of items in one's view or possession, especially a periodic survey of all goods and materials

leaking underground storage tank:
underground storage tank which has spilled, leaked, emitted, discharged, leached, disposed, or otherwise allowed an escape of its contents into groundwater, surface

water, or subsurface soils

pressurize:
to put (gas or liquid) under a greater than normal pressure

record:
an account, as of information, set down in writing as a way of preserving data collected on a specific subject

suction:
a force causing a fluid or solid to be drawn into interior space or to adhere to a surface due to the difference between external and internal pressures

underground storage tank (UST):
any tank, including underground piping connected to the tank, that has at least 10 % of its volume underground and contains petroleum products or hazardous substances (except heating oil tanks and some motor fuel tanks used for farming or residential purposes)

ADVANCE PREPARATION

A. Copy Student Sheet, Background Information, and procedure for students.

B. Put terms and definitions on the board.

C. Divide the class into work groups and hand out materials.

D. Give students time to read and discuss materials. During discussion, have groups list environmental hazards caused by USTs and discuss how they are remediated.

E. After class discussion of USTs, have students proceed with activity within their groups.

PROCEDURE

I. Setting the stage

A. The State of California's massive cleanup fund began in 1990. The

Underground Storage Tank Cleanup Fund allows UST owners to comply with new regulations by helping finance tank removal and groundwater cleanup. Funding has already assisted in "the cleanup of some 25, 700 leaking underground tanks."

B. The average cost for tank removal is about $10,000. The soil and groundwater cleanup after contamination occurs is where costs really balloon. For the purposes of this activity, the complex and individualized costs will be generalized; and a standard figure for the cleanup of leaking tanks will be set at $400,000.

C. The funds for the Underground Storage Tank Cleanup Fund are generated by a fee charged to the owners/operators of underground petroleum storage tanks. A proposal is to increase the current 0.06 of a cent per gallon to 1.2 cents per gallon fee. Estimates show that this increase would provide an additional $676 million to the "trust fund."

D. Sacramento County has 3, 390 underground tanks, of which 519 are known to be leaking and 299 have been cleaned. Yolo has a total of 572 tanks including 121 leaking ones and 65 cleaned sites. Placer County has 994 tanks including 218 leaking tanks and 31 cleaned ones. And Eldorado County has 714 tanks including 31 leaking ones and 25 that have been cleaned.

II. Activity

A. Using the data listed, determine how many USTs still need to be replaced in the four counties listed. List them individually by county and include a total. List the number of leaking tanks by county and the total.

B. Using the assumed costs, determine how much money will be needed to replace and clean up all of the tanks in the four counties listed. Include these subtotals: Cleanup for Leaking Tanks, Tank Removal for Leaking Tanks, Cleanup and Tank Removal for Leaking Tanks, Tank Removal for all Tanks, and Total Tank Removal and Cleanup.

C. Report how much money will need to be generated by the fund to accomplish final cleanup within five years (for the four counties listed).

D. At 1.2 cents per gallon, how many gallons will need to be sold to generate the needed funds for the four counties listed?

E. If the new fee passes, the 1.2 cent per gallon fee will probably be passed down to the consumers through increased gas prices. Do you feel that it is unfair to the consumers to be made responsible?

F. If the four counties contained over 2 million people, can you imagine how many USTs there would be in Los Angeles and Orange Counties, which include over ten million people? Do you think the final cleanup of all USTs in California will be achieved in five years? What other way could they generate funds?

III. Follow-up

A. Ask students where their drinking water comes from. If any get water from groundwater, ask these students if there are any USTs in their area.

B. After the class generates a survey sheet, have students interview a gas station owner or manager. Be sure they include questions about how old the tanks are, if they have caused problems, the last time they were inspected, who does the inspection, how leaks are detected.

C. Give a quiz on USTs. Ask students to define UST, list environmental problems caused by USTs, explain how problems with USTs are remediated.

IV. Extensions

A. Some of the regulatory rules for USTs are listed in this activity. Have students read over these and study the Student Sheet figures.

B. Have students find out if groundwater is checked in the local area for petroleum contamination. Who is responsible for checking on USTs in the area?

RESOURCES

Dictionary of Scientific and Technical Terms, McGraw-Hill, 1994 Ed.

Pickett, Diane, Personal Interview, Brown and Root Environmental.

"Tank Owners Brace for Shift to Private UST Coverage," National Petroleum News, Vol 87, July 1995.

"Underground Tank Owners Seek Some Clarity," The Business Journal Serving Greater Sacramento, Vol 11, August 15, 1994.

"Musts for UST's. A Summary of Federal Regulations for Underground Storage Tank Systems, Solid Waste and Emergency Response, 5403W, EPA 510-K-95-002. July 1995.

Answer Sheet

1. Tanks that need to be replaced and cleaned:

Eldorado	689
Placer	963
Sacramento	3,091
Yolo	507
Total	5,250

Leaking Tanks:

Eldorado	31
Placer	218
Sacramento	519
Yolo	121
Total	889

Non-Leaking Tanks:

Eldorado	658
Placer	745
Sacramento	2,572
Yolo	286
Total	4,261

2. Determining Costs -

Tank Removal for Leaking Tanks

# of Leaking Tanks x Cost of Tank Removal

889 x $10,000 = $8,890,000

Cleanup for Leaking Tanks

# of Leaking Tanks x Cost of Cleanup

889 x $400,000 = $355,600,000

Cleanup and Tank Removal for Leaking Tanks

# of Tanks x Cost of Cleanup + # of Tanks x Cost of Tank Removal =

889 x $400,000 + 889 x $10,000 =
$355,600,000 + $8,890,000=$364,490,000

Tank Removal for Non-leaking Tanks

# of Tanks	x	Cost of Tank Removal	=	
4,261	x	$10,000	=	$42,610,000

Total Cost for Tank Removal and Cleanup

Total for Leaking Tanks	+	Total Cost for Non-leaking Tanks		
$364,490,000	+	$42,610,000	=	$407,100,000

3. $407,100,000

4. 1.2 cents = $0.12

fee per gallon	x	# of gallons sold	=	amount generated
$0.12	x	# of gallons sold	=	$407,100,000

Divide by $0.12 on both sides of the equation

# of gallons sold = 3,392,500,000