

Auto & Truck Tires

name/date/period

(adapted from Laboratory Investigations for AP Environmental Science)

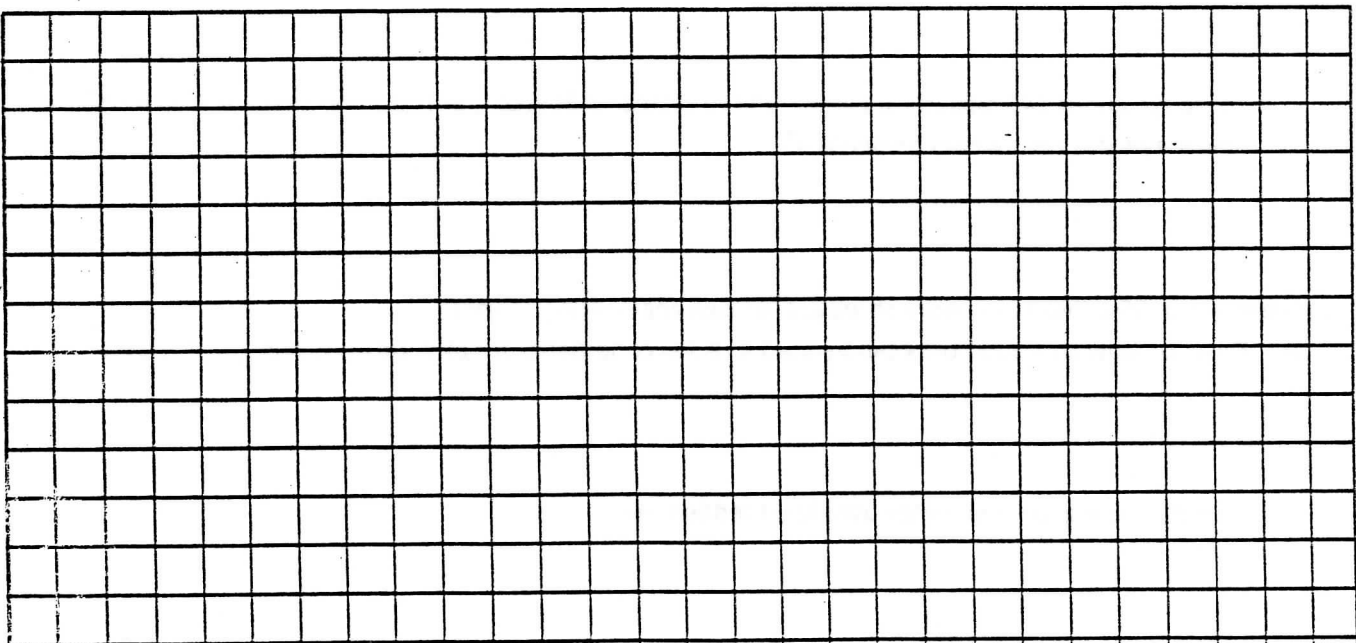
Introduction: Drivers in the United States discard approximately 280 million tires per year. When these tires are discarded, they collect water and breed mosquitoes, which can spread diseases. Even when buried, tires can work their way back to the surface. Most tire piles are outdoors on open ground, where they pose a serious fire hazard. A tire pile in Winchester, Virginia, burned for nine months. In this fire, 7 million tires burned for 275 days, and released 690,000 gallons of oil. One site in Stanislaus County, California, had tires piled as high as six stories, holding over 30 million tires. By 1999, it was down to about 7 million tires when lightning started a fire that burned for over a month. One way to remove a pollutant or waste product from the environment is to make it into a profitable commodity. There have been many creative ways to use old tires in an attempt to reduce tire piles. Tires have been used in the making of artificial reefs off the coasts of New Jersey and Delaware. They have been ground up into pieces, called crumb rubber, that are a few millimeters in diameter and used for stabilizing hillsides and as conditioner for soils, increasing the soil porosity and improving plant root growth. Crumb rubber is mixed with paving asphalt to improve the durability of highways. Whole tires and crumb rubber are used as fuels for power plants and cement manufacturing.

Figure 31-2: California Tire Diversion Rates (in millions) 2003.

Year	# tires generated	# tires reused	# tires recycled	# tires retreaded	# tires to fuel	total # diverted	% of tires diverted
1997	33.2	1.5	5.4	2.8	9.0		
1998	33.8	1.5	9.1	2.8	7.5		
1999	34.0	2.4	10.1	2.5	7.9		
2000	34.5	3.6	13.0	2.4	5.2		
2001	34.8	1.5	14.9	2.4	5.2		

Analysis

1. As seen in the Tire Diversion chart, recycling is the most efficient method of reducing old tires in recent years in California. Complete the chart, using the description of the various columns.
 - a. Below, plot the number of tires diverted compared to the total number of tires generated each year.
 - b. Based on your graph, predict the number of tires diverted in 2004.



2. One tire can generate about 250,000 BTUs. The average American home consumes about 10,000 kilowatt-hours per year. Assume one BTU equals about 3×10^{-4} kWh and production of electricity from tires is 60% efficient.
 - a. How many tires would be needed to supply the 10,000 kWh per year?
 - b. Suppose 30% of the tires discarded in California in 2001 were burned for electric power at 60% efficiency. How many homes would that supply with electricity?
 - c. Assume 1 pound of coal produces 12,000 BTUs. How many tons of coal would be used per home (ie. How much would be saved by using the tires)? (1 ton = 2,000 lb)
3. Whole tires can be used as the energy source in kilns that make cement by heating limestone to over 2,500°F. At temperatures that high, no toxins are released. By this process, a single kiln can use 2 million tires per year, saving more than 2 gallons of oil, or 25 pounds of coal, per tire used. One ton of coal produces 80 pounds of sulfur dioxide, a major cause of acid rain. But tires have much lower sulfur concentrations than coal. By using tires in a cement kiln instead of coal, how many tons of sulfur dioxide are kept out of the environment?
4. One way to keep tire piles from being a problem is by conservation. By allowing our tires to last longer, they do not need to be replaced so quickly. The major cause of increased tread wear is underinflation. Driving a tire that is 20% underinflated can reduce the life of the tire by almost 10,000 miles. It also lowers the fuel economy of your vehicle by 4-5%.
 - a. The average normal tire will drive 45,000 miles. If the tire is 20% underinflated, how far can it be driven under otherwise normal conditions?
 - b. There are about 140 million cars in the United States. If 50% of them had tires that were underinflated, how many extra tires would be needed?
5. Last year, about 30 million tires were shredded for civil engineering projects.
 - a. Describe how shredded tires can be used as a soil conditioner for athletic fields and golf courses.
 - b. Identify and explain two other uses for shredded tires.