CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
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Project Number
J0320

Project Title
Pump it Up! The Effect of Tire Pressure on Bicycle Efficiency

Abstract

Objectives/Goals
Gasoline for cars is becoming an expensive and valuable resource. Everyone looks to save on car fuel, but there appears to be no easy solution. One often-overlooked solution to this problem may be to keep the tires of your car properly inflated. I decided to investigate the effect of tire pressure on bicycle efficiency, since this model could be directly applied to car fuel consumption. Based on my research, I learned that tire pressure in the wheel maintains the shape of the wheel, and so the highest tire pressure is usually the most efficient. I hypothesized that if I lower the bicycle's tire pressure, then the efficiency will decrease.

Methods/Materials
To test my hypothesis, I measured the speed of bicycle down a 100-meter downhill course with tire pressures at 10, 20, 40, and 60 psi. For these experiments a rider sat passively on the bicycle, not pedaling but keeping the bicycle straight. For an additional endpoint, I measured the rolling resistance at these same pressures. Rolling resistance was defined as the force (measured by a force gauge) that is required to pull a bike at 10 miles per hour. All experiments were conducted using 2 different bicycles of wide (2.1#) and narrow (1.125#) tire width. For all experiments the statistical significance of the data were examined using a student's paired-T test.

Results
For the bicycle with the wide tires, supporting my hypothesis, the greatest speed (4.64 m/s) was obtained with highest tire pressure (60 psi). The differences in speeds at the varying tire pressures were small but reproducible and statistically significant. Rolling resistance tests further validated my hypothesis. The highest tire pressures also gave lowest rolling resistance (2.583 lbs). However, the significance of the measured rolling resistance data was less than the speed measurement, due to the limits of the experimental method. The experiments conducted using a bicycle with more narrow tires gave similar results.

Conclusions/Discussion
Supporting my hypothesis, bicycle efficiency decreased as tire pressure was lowered. My results showed that by decreasing the tire pressure by just one pound per square inch (psi) you can lose up to 0.2% of your bicycle efficiency. This data can directly be applied to car fuel consumption. Gasoline for cars is a dwindling and expensive resource, which can be preserved if drivers took the simple and direct step of properly inflating their tires.

Summary Statement
My project investigates the effect of tire pressure on bicycle efficiency as measured by both speed and rolling resistance.

Help Received
Mother helped arrange board; Father helped conduct a student's paired T-test