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Gasoline has gone through many changes in the last couple of decades, both for efficiency and for environmental considerations. During the early 20th Century, the oil companies were producing gasoline as a simple distillate from petroleum, but the automotive engine was rapidly being improved and required a suitable fuel. Engines were modified to run on kerosene, however kerosene-fueled engines would “ knock” and crack the cylinder head and pistons. This then led to the long search for antiknock agents, culminating in tetra ethyl lead. Typical mid-1920’s gasoline was 40-60 octane.

The 1950s saw the start of the increase of the compression ratio, requiring higher octane fuels. Octane ratings, lead levels, and vapor pressure increased, whereas sulfur content decreased. Minor improvements were made to gasoline formulations to improve yields and octane until the 1970s – when unleaded fuels were introduced to protect the exhaust catalysts that were also being introduced for environmental reasons. From 1970 until 1990, gasoline was slowly changed as lead was phased out, lead levels plummeted, and octane initially decreased. With the passage of the US Clean Air Act of 1990, significant compositional changes in gasoline began to be forced on the industry to minimize this major pollution source, and these comprehensive changes are expected to continue well into the 21st Century. Oxygenates, which are actually pre-used hydrocarbons, have been sparingly used in gasoline since the 1970’s for their anti-knock value.

Today they are increasingly added to gasoline because research seems to indicate that they help reduce the smog-forming tendencies of exhaust gases by reducing the reactivity of the emissions; therefore making the gases less environmentally harmful. Oxygenates can now replace high-

octane aromatics in the fuel, thus dramatically reducing the CO and HC emissions (the “ aromatic substitution effect”). Another advantage to increasing the oxygenate levels in gasoline seems to be that they improves octane levels, but this is still being studied. When tetra ethyl lead (TEL) was first introduced into gasoline during the 1920’s, it became the most cost-effective way to enhance octane while reducing engine knock. This led to major gains in engine efficiency and lower gas prices, which pleased the nation. The toxicity of TEL was apparent from the outset, but people were willing to accept the trade off for cheap, efficient fuel.

Up until the late 1960’s, these leads were added to gasoline in increasing concentrations to obtain greater and greater octane. By then, the toxicity of the emissions from gasoline-powered engines was becoming of increasing concern and there was a frantic search begun for an exhaust catalyst that was lead-tolerant. When nothing practical could be found, lead was on its way out as a gasoline additive. The catalytic converters used today are extremely sensitive to lead and thus the gasoline formula had to be radically changed to exclude lead. This has had a very positive effect on the environment by reducing the aggregate emission of lead by more than 95%! The known long term effects of chronic exposure to lead in humans results in damage to blood, central nervous system (CNS), blood pressure, kidneys, reproductive systems, and Vitamin D metabolism.

Children are particularly sensitive to the chronic effects of lead, with slowed physical and cognitive development and reduced growth especially affected. The largest source of lead in our atmosphere had been from leaded gasoline combustion, but with the phase-out of this lead source, air lead levels have

decreased considerably. This is good because lead has been shown to bioaccumulate in the environment and continues to pollute. With the removal of lead and the immediate introduction of exhaust catalysts and sophisticated engine management systems, the United States has made great strides in maximizing environmental and health gains in this area. When gasoline molecules in a car’s engine do not burn completely, hydrocarbon emissions occur.

The hydrocarbons react with nitrogen oxides and sunlight to form ground-level ozone, a major component of smog. This smog irritates the eyes, damages the lungs, and aggravates respiratory problems. A number of exhaust hydrocarbons are also toxic, with the potential to cause cancer. To combat this, fundamental improvements in engine design have been made, charcoal canisters have been added to collect these hydrocarbon vapors, and exhaust recirculation valves have been installed to reduce the nitrogen oxides.