FUEL COMBUSTION MODIFIER TECHNOLOGY (FCM)

PT Fuel Combustion Modifier technology (FCM) was developed during the past 20 years for the purpose of commercializing low cost, environmentally clean production of materials for various commercial and industrial applications developed for the Department of Defense. During that time, an in depth understanding of combustion processing in an internal combustion chamber of an engine evolved towards the present Fuel Combustion Modifier.

The key process patents, based on inventions dating from the 1970's, were under U.S. Government secrecy orders for many years. The creation of new materials has led directly to the development of fundamentally new products for commercial applications.

The PT fuel combustion modifier originated in a U.S. Navy research program to reduce the explosion hazard created by misted aviation fuel in a crash. Researchers discovered that by adding a combination of several molecular polymers to jet fuel greatly reduced the rate of energy from the ignition of misted fuel. At the same time, they saw that addition of these polymers to the jet fuel eliminated the dense black cloud of smoke associated with misted fuel ignition. It was this latter discovery that led to investigation of how this phenomenon could be used to improve combustion in internal combustion engines.

Follow-on investigation discovered that the addition of a complex combination of polymers and other materials to fuel modified the physical properties of a sprayed fuel in a number of ways, which contribute to improve combustion in an engine. Super-fine, vapor like, droplets are eliminated, droplet size and distribution across a spray cone are more uniform, this means that volume diameter of the droplets is reduced and fractional distillation of sprayed fuel is inhibited.

The PT Fuel Combustion Modifier Technology (FCM) is a unique approach to improving combustion efficiency by modifying gasoline's physical properties in a way that makes the air/fuel mixture more uniform and repeatable from cycle to cycle.

More than 60% of the energy in gasoline is lost in the combustion process, or put another way, only 40% remains to be converted to mechanical energy needed to move a vehicle. Diesel Engines are somewhat more efficient. It is well known that one way to improve this ratio is by improving the homogeneity of the fuel/air mixture that burns in a cylinder. Engineers have worked hard to solve this problem, especially during the last decade under public pressure to reduce automobile emissions. Part of that lost 60% of gasoline's energy become waste products, such as carbon monoxide and unburned hydrocarbons, the auto emissions that EPA has pledged to eliminate.

However, engineers can go only so far. For example, they can shape intake valve ports to cause air and fuel to tumble and swirl in a mixing motion. But they cannot deal with a characteristic of gasoline that interferes with forming a homogeneous fuel/air mass. Gasoline has physical properties, which have a significant adverse effect on mixture preparation. First, gasoline is made up of many different components, which vaporize at different temperatures. This property results in fractional distillation of gasoline, which in turn causes spatial separation of fuel species in the air/fuel charge. Because different fuel components burn differently, their spatial separation influences ignition and flame propagation. Second, gasoline is a Newtonian fluid, which has properties that inhibit uniform spray formation, regardless of nozzle design. Similarly, the Newtonian nature of gasoline establishes its wall-wetting behavior when gasoline contacts a metal surface in the induction area of an engine. Poor uniformity of droplet and distribution across the spray cross-section and wall film formation in the induction channel cause poor air/fuel mixture preparation. It has been demonstrated that this lack of gasoline homogeneity leads to incomplete combustion and emissions.

PT Fuel Combustion Modifier Technology (FCM) uses a complex combination of polymers and other materials to modify the gasoline's vaporization, spray formation and physical properties in a way that makes the air/fuel mixture more uniform and repeatable from cycle to cycle. Extensional effects of the FCM molecules inhibits vaporization of the low boiling components from spray droplets in the induction cycle until heat developed in the cylinder surface vaporization of all components uniformly. The results is a more uniform mixture of all fuel components in the air/fuel charge at ignition and during burn. More energy can be released from a fuel in this manner, which equates to a more efficient engine and less of the fuel's energy is lost as heat and unburned hydrocarbons resulting in reduced engine temperature and pollutants. Extensional effects of the FCM also causes finer, more evenly distributed spray droplet formation. Droplets of gasoline containing the FCM are more resilient than droplets of a Newtonian fluid and have a tendency to bounce or reflect off a surface rather than splashing and coating. This change in gasoline physical's properties results in more gasoline being entrained in the air/fuel charge entering the cylinder in cold starts and in transient conditions. In gasoline engines, mechanical efficiency is improved, fuel consumption is reduced, operating temperatures are reduced and emissions of CO, HC and Nox are reduced.

PT Fuel Combustion Modifier Technology (FCM) also works in diesel engines. Even though gasoline and diesel injection systems are different, fuel/air uniformity is a common problem. In the diesel engine fuel is sprayed into the cylinder during the compression stroke. The objective is to get the fuel evenly distributed in the highly compressed hot air mass prior to and following ignition. However, there are many problems:

- Fine vapor like, droplets ignite the mass of fuel
- Droplets collide forming large slow burning droplets
- Droplets shear into fine fast burning droplets
- Droplets coat cylinder walls where the fuel cools and burns slowly and incompletely

Maintaining the integrity of fuel droplets after injection in a diesel engine solves many of the fuel/air uniformity problems. The droplets like fine vapor are eliminated. FCM droplets resemble a solid and resist combining with another droplet by collision. FCM /Droplets resist shearing into fine droplets passing through high pressure gas. FCM/Droplets act more like a solid ball than a liquid when they contact a cylinder wall restricting splatter and coating. Overall, the original droplet size is maintained until they burn diffusely from the surface. The result is, like with gasoline, a more homogeneous mixture of fuel and air. The flame front is more uniform and combustion more complete. In diesel engines, mechanical efficiency is improved, combustion gas temperatures are reduced, fuel consumption is reduced and emissions of particulate matter and Nox are reduced.

One of the active components of PT Fuel Combustion Modifier (FCM) technology is an ingredient to keep clean the internal parts of an engine by removing deposits as required by the EPA. It is also an ingredient in additives for diesel engines for keeping injectors free of deposits.

COMPETITIVE ADVANTAGES

PT Fuel Combustion Modifier Technology (FCM) is an important step forward in combustion technology. A small addition improves combustion efficiency in both gasoline and diesel engines.

When PT Fuel Combustion Modifier Technology (FCM) is added to diesel fuel the operating temperature in the diesel engine decreases. This implies that the cetane value of the fuel, when compared to that of the unfortified fuel has increased. When the temperature of the exhaust gases decreases, the fuel has experienced more complete combustion and more chemical potential energy has been converted to work and less heat, i.e. mechanical efficiency is improved. Combustion gas temperatures are reduced, fuel consumption is reduced and emissions of particulate matter and Nox are reduced. Each of these events leads to more power produced at the crankshaft.

The pre-market and post-market additives mixed with fuels today, derive most of their effectiveness from chemical reactions that contribute to, inhibit or catalyze. These additives effect the chemistry of the fuels, whereas the FCM technology changes the physics of droplet formation by altering the way fuel atomizes. Increased combustion efficiencies lead to greater fuel economy (mileage), reduced emissions, lower maintenance and better engine performance. Competitor's products may improve performance temporarily by freeing deposits that prevented an engine from operating as it was designed. FCM technology on the other hand, will improve the performance of even new automobile.

PT Fuel Combustion Modifier Technology (FCM) has many advantages over the competition. It does improve performance, fuel efficiency and reduces emissions. Drivers will notice a difference in performance, including smoother running, easier starting, more power, even a change in exhaust odor. We believe that FCM Technology also will have important long-term benefits, such as lower engine wear (through uniform combustion and lubrication) and cleaning the combustion system deposits.

Although not an oxygenate PT Fuel Combustion Modifier Technology (FCM) achieves the results targeted for oxygenated fuels (lower emissions) without the negative environmental impact of current oxygenates, at a much lower final cost to consumers.
FCM Technology can also increase refinery capacity by increasing the boiling point range in reformulated gasoline and eliminate complexities producing, distribution and storing "boutique" fuels.