AFC PRODUCT BINDER

Ultra Premium Broad-Spectrum Fuel Additive Concentrate

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AFC-705
Broad-Spectrum Fuel Catalyst

AFC-705 is a unique and powerful broad-spectrum fuel additive specifically formulated for use in diesel, bio-fuels, gasoline, kerosene, and heavy fuel oil. AFC-705 should be used as part of any preventative fuel maintenance program. AFC-705 enhances the breakdown and removal of sludge, slime, and bio-fouling from tank walls and baffles that are difficult to access. AFC-705 effectively decontaminates and cleans an engine's entire fuel and injection system. It continues to work in storage tanks, cleaning and stabilizing fuel for up to 12 months with a single dose. AFC-705 is ideally used for applications where there is high turn-over fuel such as: commercial and non-commercial vehicles, heavy equipment, recreational and work boats, and smaller engines.

AFC-705 SPECIFICATIONS

Active Ingredients	Combustion Catalyst, Dispersant, Surfactant Corrosion Inhibitor, Lubricity Enhancer
Treament Ratio	1:5000
8oz Bottle	320 Gallons (1,211 Liters)
1 Gallon Jug	5,000 Gallons (18,927 Liters)
5 Gallon Jug	25,000 Gallons (94,635 Liters)
55 Gallon Drum	275,000 Gallons (1,040,988 Liters)

AFC-705 FUEL CATALYST

A unique and powerful broad-spectrum concentrate for use in diesel, bio-fuel, gasoline, kerosene, and HFO. Benefits include:

- Extends Engine Life
- Extends Filter Life
- Removes/Prevents Carbon Build Up
- Prevents Corrosion
- Cleans Injection System
- Stabilizes Fuel up to 12 mo.
- Adds Lubricity
- Improves Combustion
- Lowers Emissions
- Improves Fuel Economy

Using AFC-705 accelerates tank cleaning and the fuel restoration process. It enhances the breakdown and removal of sludge, slime, and bio-fouling from tank walls and baffles that are difficult to access. AFC-705 effectively decontaminates and cleans the entire fuel and injection system. It continues to work in storage tanks cleaning and stabilizing fuel for 12 months or longer.

1.239.690.9859
1.877.425.4239 Toll Free
www.AXI-International.com

AFC-710

Tier 4 Compliant Broad-Spectrum Fuel Catalyst

AFC-710 is a unique and powerful Tier 4 compliant broad-spectrum fuel additive specifically formulated for HPCR (High Pressure Common Rail) engine use with diesel, bio-fuels, gasoline, kerosene, and heavy fuel oil. AFC-710 should be used as part of any preventative fuel maintenance program and is ideal for use in high turnover and bulk storage fuel tanks. AFC-710 enhances the breakdown and removal of sludge, slime, and bio-fouling from tank walls and baffles that are difficult to access. AFC-710 effectively decontaminates and cleans an engine's entire fuel and injection system. It continues to work in storage tanks, cleaning and stabilizing fuel for up to 12 months with a single dose.

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Introduction

The AFC Series of fuel additives is a high performance, broad-spectrum, catalyst oxide fuel concentrate. It combines combustion surface modifiers with lubricity enhancers, corrosion inhibitors, surfactants (AFC-705 only), and dispersants in a unique formulation that is second to none. AFC removes and prevents carbon-based deposits in the combustion chamber, eliminates and prevents microbial contamination, prevents fuel filter clogging, and prevents the build up of sludge in fuel storage and fuel delivery systems. The powerful concentrate only requires a small dosage of the additive to decontaminate the entire fuel system, restoring fuel quality, and extending fuel life.

The immediate results of using AFC include:

1. Clean and decontaminated fuel system
2. Significantly reduced fuel consumption
3. Reduced harmful exhaust emission
4. Smoother running engines
5. Reduced smoke
6. Increased performance

The Benefits of AFC

The key components of the AFC formula are the driving force behind the power of AFC. Derived from its unique formulation of dispersants, surfactants (AFC-705 only), and deposit surface modifiers, AFC specifically targets the problems of contaminated fuel systems in storage tanks and deposits in engines, turbines, and burners.

Remove Engine Deposits

The combustion catalyst in AFC removes carbon deposits by interacting with the heavier, long-chain, combustion resistant elements of the fuel, by lowering the energy of activation. This allows the release of carbon in the form of CO2 at a lower temperature.

Prevent Deposit Formation

The catalytic components inhibit the agglomeration process from forming heavy deposits. The agglomeration process is stopped at the primary and secondary particle formation phase, resulting in smaller, lighter particles.

Reduce Fuel Consumption

Deposits in the combustion chamber prevent the fuel from complete combustion. AFC promotes the combustion process by utilizing the stored energy in carbon deposits, leading to more efficient conversion of the fuel to CO2. As the engine detects the change, it recognizes it does not need the same amount of fuel to be delivered to sustain operation, and adjusts accordingly.

Reduce Emissions

As deposits are removed, the emissions of carbon monoxide (CO), nitrous oxides (NOX), sulfur oxides (SOX), hydrocarbon (HC) particulate, and other forms of soot are drastically reduced, as the fuel is being consumed more completely and efficiently.

Reduce Carbon Content of Ash

AFC interferes with the agglomeration of combustion by-products by enhancing CO2 production. With less carbon available to end up in the ash complex, the amounts of ash or soot will be significantly reduced.

Cooler Exhaust, Lower NO_X

Fuel has a limited amount of energy that becomes available during the combustion process through the production of CO2. The catalytic components in AFC enhance the combustion process. When more of the fuel's energy is released during the combustion phase, less energy will be available to be released during the exhaust phase. The difference in energy release correlates to a temperature difference. Higher energy release in the combustion chamber means lower energy release during the exhaust phase, which results in lower production of NOX.

Extend Lube Oil Life

Most diesel engines use fuel as a source of engine lubrication. AFC treated fuel produces smaller and less abrasive particles, which in connection with the removal of deposits, result in cleaner, longer lasting lubrication oil. This leads to reduced engine wear, less maintenance and down time, and lower operating cost.

Extend Equipment Life

Engine life can be significantly increased as the result of complete deposit removal, cleaner oil, and reduced friction. The complete and proper combustion of fuel prevents knocking, a symptom of inefficient combustion, that occurs after the standard combustion timing. This unintentional knock sends a shockwave through the rotational assembly of the engine that can cause undue stress and wear. With AFC, injectors, valves, rings, and other associated parts do not wear as quickly, promoting a longer lifecycle for the engine.

Enhance Fuel Lubricity

Over the years, government regulations have required the reduction of the sulfur content in diesel fuel. The process of removing sulfur also reduces the lubricating properties of the fuel. AFC contains a lubricity-enhancing agent that promotes less friction between moving parts.

Corrosion Inhibition

Prevent the corrosion process with AFC's corrosion inhibitor. This multi-functional component, as part of the fuel stabilization process, ensures the fuel does not oxidize. This same component ensures the entire fuel system is protected from corrosion.

Tank Cleaning with AFC

The normal aging process of the fuel is often accelerated by microbial contamination, chemical incompatibility, and condensation of water in the fuel tank. Oxidation, polymerization, and stratification will lead to darkening of the fuel, the build up of tank sludge, filter clogging, corrosion, and fuel breakdown. A slimy, jelly-like layer will develop at the water/fuel interface, while a bio-film is growing on the bottom, walls, and baffles of service and storage tanks, fuel lines, and delivery systems.

The process of fuel breakdown is most severe in the bottom of tanks. Every time a tank is topped off with fresh fuel, the existing fuel is contaminated with new oxygen that accelerates the problem. It is easy to overlook the symptoms of this continuous process of fuel breakdown.

Symptoms of contaminated fuel include:

- Frequent clogged filters
- Fouled and corroded injectors
- Excessive engine smoke
- Loss of power and RPMs
- Fuel pump problems

Frequent filter changes and fuel renewal have become accepted as standard periodic maintenance. By monitoring fuel quality, and utilizing the available AXI International intelligent fuel maintenance technology, engine users can prevent inevitable catastrophic engine failure from happening.

Traditionally, tank cleaning involved filtering the fuel in the tank, removing the fuel for filtration, or complete fuel disposal. This also often came in conjunction with opening the tank and physically removing tank sludge and bio-film. All of these techniques are time consuming, costly, and only partially effective. Filtration will only remove the suspended debris and has no effect on the bio-film growing on tank walls, bottom, and baffles, or on the process of fuel break down. At best, only temporary relief at an extremely high price can be expected.

The use of AFC will completely decontaminate and clean the entire fuel system, ensuring optimal fuel quality, enhanced combustion, and reduced emissions.

Lubricity Enhancer and Corrosion Inhibitor

During the process of removing sulfur from fuel, the natural lubricating properties in fuel are reduced. The components used to formulate the lubricity enhancers in AFC work to offset these reduced lubricating properties in two different ways, over two different temperature ranges.

The first component works by coating the surfaces with a protective lubricating film. This film also acts as a corrosion inhibitor, which keeps the parts clean and free of pits. The film works best at lower temperatures, up to about 300°C (572°F), and is constantly being replenished, as it is broken down by friction and heat.

The second component breaks down large abrasive particles into smaller smoother particles. This component works at temperatures higher than 200°C (392°F), and continues to work in conjunction with the combustion catalyst once it enters the combustion chamber.

Together the two components address corrosion, lubrication, and friction problems over the entire engine operating temperature range. AFC lubricity enhancers will not change the fuel specifications in any way. The sulfur content, BTU value, and other specifications will remain unchanged.

The principle benefit of AFC lubricity enhancers is the extended life of engine parts that rely on the fuel for lubrication. Keeping these parts operating as intended solves many of the problems related to using ultra low sulfur diesel fuel.

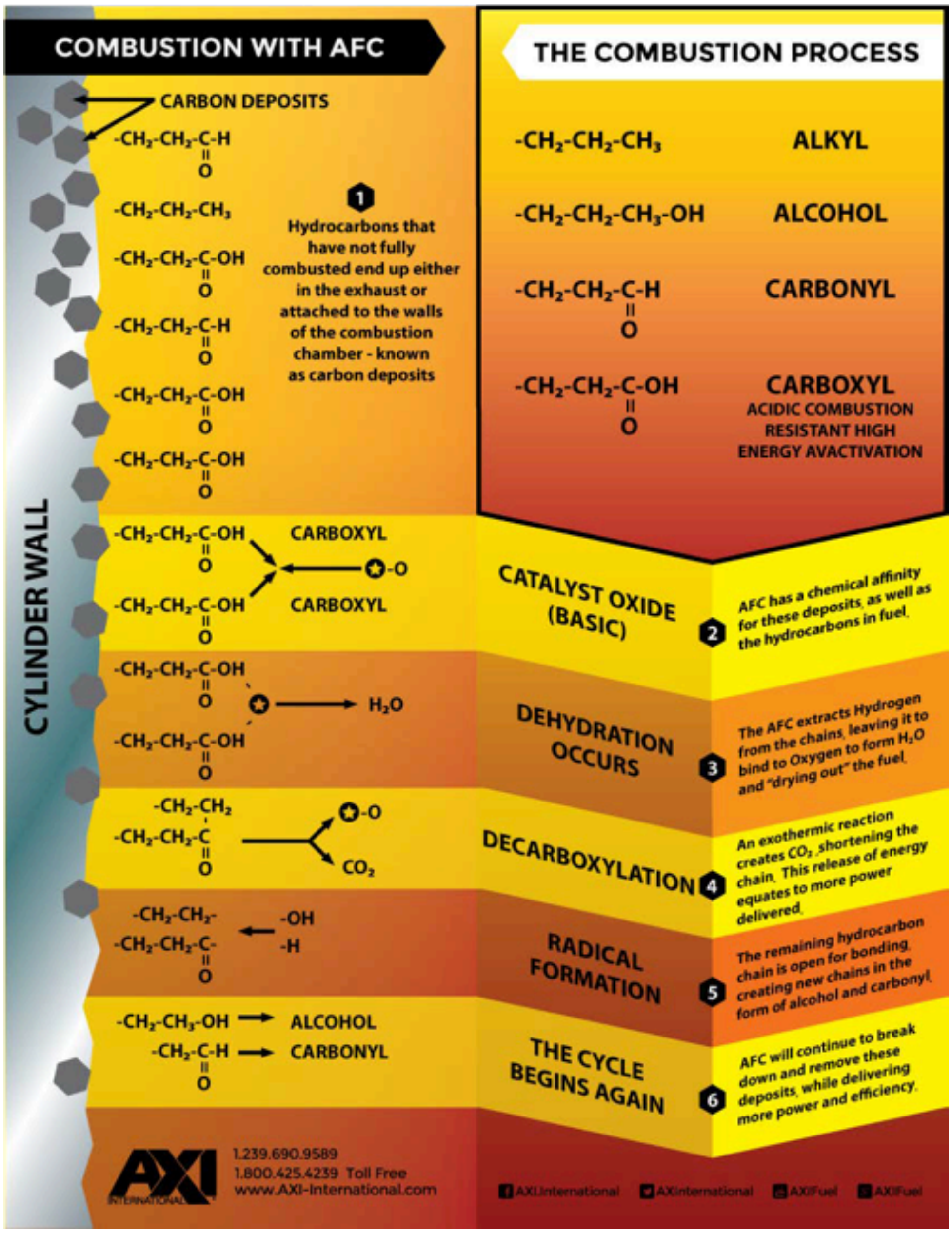
AFC lubricity enhancers ensure engine parts are more resistant to acid corrosion, showing less wear related to carbon grit. As a result, engine lubricating oil will stay cleaner for much longer. The mineral content, carbon grit, and acid forming compounds in the oil will be much lower. AFC lubricity enhancers will not interfere with crankcase oil additives.

As in any maintenance situation, the effectiveness of AFC lubricity enhancers does not replace good maintenance practices. However, its use will significantly reduce maintenance requirements and down time, while extending equipment life.

Effects of AFC on the Combustion Process

AFC interacts with the heavier, long-chain, combustion resistant elements of the fuel and existing carbon deposits. This interaction allows these deposits to break down and burn. The "molecular atomization" of the fuel, and the destruction and burning of the surface deposits, produce the following positive effects on the combustion process:

- Quicker, more complete combustion
- Optimal use of available oxygen
- Lower excess air requirements
- Removal of existing deposits
- Better heat transfer
- Lower fuel consumption
- Increased overall efficiency



Effects on Combustion Byproducts

AFC enhances the combustion process, which leads to the following positive effects on combustion byproducts:

- Removal of old carbon deposits
- Prevention of new deposit formation
- Decrease in fuel consumption
- Decrease in particulate, smoke, soot, NOX, SOX, CO, and VOC emissions
- Decrease in carbon content
- Decrease in fouling and corrosion due to decreased V_2O_5 activity
- Decrease in cold-end corrosion due to decrease in SO_3 formation

These effects lead to a significant increase in energy output by burning a larger portion of the carbon available in fuel, and a significant reduction in corrosion due to much lower formation of SO_3, which increases the amount of SO_2 harmlessly captured in ash.

How AFC Works on Deposits

Combustion chamber deposits are mostly carbon and aromatic compounds in a highly combustion resistant state. These deposits are the source of many engine problems, such as higher than normal fuel consumption, excessive harmful exhaust, and costly maintenance. Fuel problems and incomplete combustion ultimately cause complete engine failure.

Deposit formation begins with spherical molecules, called primary particles, and branched aromatic chains, both of which are produced in the early stages of combustion. The chain branches consist of alkyl, alcohol, carbonyl, and carboxyl compounds. The alkyls oxidize to alcohol, oxidizing to carbonyl, oxidizing to carboxyl. The oxidation process stops with the carboxyl compounds, which are acidic and highly combustion resistant with a high energy of activation.

The various branch compounds are attracted to the primary particles, which spin at extremely high velocities. When a branch becomes attached to a primary particle, the entire chain structure is quickly wrapped around the primary particle, forming a secondary particle. These secondary particles agglomerate, forming tertiary particles. This can happen when several primary particles become attached to the same chain on different branches, and then simultaneously become secondary and tertiary particles, as they wrap up the chain.

Tertiary particles agglomerating on a surface will become further coated to form quaternary particles. The coated quaternary particles make up deposits. The chain structures coating the surface of deposits leave exposed branches. It is at these branches where the AFC catalyst begins to break down and destroy the deposits as it modifies the surfaces.

The carboxyl branches are acidic, attracting the AFC catalyst oxide, which is basic. When the two combine, a process called dehydration occurs, and a water molecule is produced. What remains is a compound with a low energy of activation, which readily breaks down at high temperatures, releasing a CO_2 molecule and the catalyst oxide.

Upon releasing the CO_2 and the catalyst oxide, the end of the chain re-oxidizes to an alkyl, alcohol, or carbonyl compound, and finally to a carboxyl compound. When the end of the chain reaches this state, the catalyst oxide once again combines with the carboxyl and starts the break down cycle again. Over time, the deposits are removed by being converted to CO_2 and water.

AFC inhibits the formation of new deposits in much the same way as it destroys existing deposits. It interacts with the ends of the aromatic chains and the attachment sites on the primary particles. This interaction keeps the primary particles from wrapping up into full chains by blocking or destroying the attachment sites and breaking the chains.

This interference stops the deposit agglomeration process at the primary and secondary particle agglomeration stage. The result are much lighter and smaller particles that are more easily oxidized and don’t stick together. The interference lowers the mass of particulate emissions, increases energy output, and increases production of CO_2 and water, all of which are the desirable end products of the combustion cycle.

Eliminating Combustion Deposits

AFC technology is based on the catalytic effects of organo-metallics. The main active ingredients are synergistic, multi-functional combustion catalysts, containing combustion surface modifiers and deposit surface modifiers. AFC can be used with any liquid hydrocarbon fuel such as gasoline, diesel, residual fuel, and HFO.

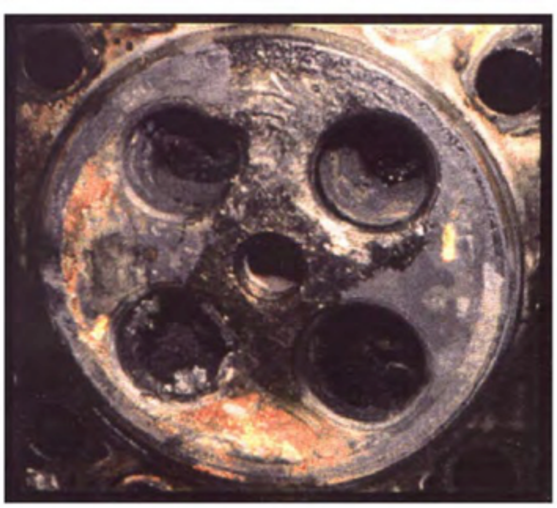
A typical engine develops a temperature gradient ranging from 200°C (392°F) at the combustion chamber wall, to 1200°C (2192°F) in the combustion center. Many of the fuel components require a higher temperature than 600°C to combust. It is not possible to completely burn heavy fuel components in temperatures ranging from 200°C – 600°C (392°F - 1112°F). Incomplete combustion causes deposits, harmful emissions, and consequential mechanical problems.

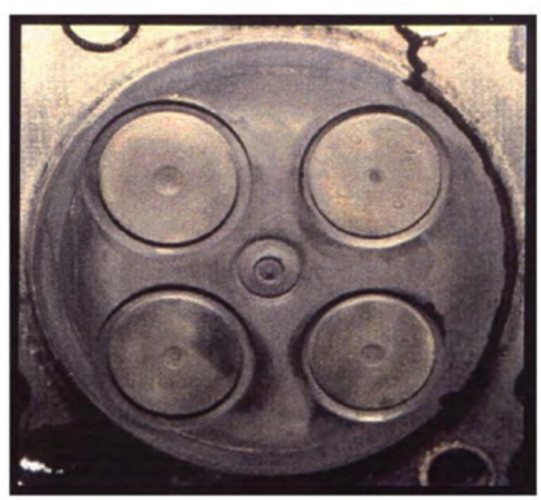
Combustion chamber deposit surfaces and fuel particles treated with AFC begin to combust at temperatures as low as 200°C (392°F), and then burn over the entire temperature range. This results in complete combustion, and eventually, total removal of all engine deposits, while preventing new deposit buildup. Complete combustion leads to better performance, lower fuel consumption and lower emissions (CO, SOX, NOX, HC, and PM-10), which lead lower operating cost, maintenance and downtime.

The process of deposit removal begins immediately, and can take up to 600 hours or 4,000 miles. The actual time needed depends on operation, history, and age of the equipment. AFC treated fuel completely removes the deposits from fuel injectors, intake and exhaust valves, and other exposed combustion chamber parts of dirty engines while preventing deposits in new engines.

In older engines, the use of AFC treated fuel is even more pronounced than in new engines. The performance of new engines will not degrade, and maintenance will remain at a minimum.

Fuel treated with AFC burns completely, resulting in new engines staying clean, while older, dirty engines become clean. AFC is the most cost effective way to conserve energy and protect the environment while enhancing performance and engine life.





The Effects of AFC on SO_X

The treatment of carbon-based fuels with AFC has a significant effect on trace sulfur combustion chemistry. In diesel engines, gasoline engines, and open flame applications (boilers), the use of AFC treated fuel will significantly reduce sulfur oxide (SOX) emissions, and related sulfur acid corrosion problems.

AFC does not react with the sulfur in the fuel, nor does AFC have any effect on the sulfur content of the fuel. AFC does not affect fuel specifications at recommended treatment levels. Fuel containing one percent sulfur prior to AFC treatment will still contain one percent sulfur after AFC treatment. However, the use of AFC will determine where the sulfur ends up, and what its chemical state will be after combustion.

The combustion of sulfur in fuels invariably leads to the formation of sulfur dioxide $S + O_2 + SO_2$, and sometimes sulfur trioxide $2SO_2 + O_2 + 2SO_3$. Sulfur trioxide formation is catalyzed by vanadium pentoxide (V^{5+}). This is the most stable oxidation product of vanadium when fuels containing vanadium are burned in air $4V + 5O_2 + 2V_2O_5$. The catalytic effect is thought to relate to the reversible dissociation $2V_2O_5 + 2V_2O_4 + O_2$ at temperatures between 700°C -1125°C (1292°F - 206°F). The sulfur trioxide reacts with water vapor to form sulfuric acid $SO_3 + H_2O + H_2SO_4$, which is primarily responsible for acid corrosion problems in combustion equipment.

AFC affects the production of gaseous SOX emissions. It enhances the formation of CO_2 during the combustion cycle, thus limiting the amount of SOX produced during the exhaust cycle. The increased production of CO_2 reduces the amount of excess O_2 available for other reactions. The difference in the amount of CO_2 produced during the combustion and the exhaust cycles correlates to a temperature differential. This temperature differential results in lower exhaust temperatures and shorter heat transfer times.

Minerals contained in fuel are generally oxidized to metal oxides during the combustion process. When vanadium is oxidized to V^{5+}, the production of sulfur trioxide increases due to reversible dissociation, and sulfuric acid is ultimately formed. The use of AFC inhibits the formation and reversible dissociation of V^{5+} during the exhaust phase by limiting the available O_2, high temperatures, and time periods needed for these reactions to occur.

This greatly reduces the catalytic effect V^{5+} has on the formation of sulfur trioxide, and thus the formation of sulfuric acid. By reducing the catalytic effect of vanadium, AFC promotes the combination of SOX compounds with other minerals in the fuel, such as Na and Ni. This leads to the formation of stable mineral salts and mixed mineral sulfates found in the clinker or fly ash.

AFC decreases the gaseous sulfur emissions by producing more of the particulate portion of the combustion residue products. AFC treated fuels will show slightly higher sulfate content in the ash than untreated fuel.

The Effects of AFC on NO_X

The formation of NOX takes place when combustion temperatures reach above 2500°F (1371°C) and pressures are the highest. This occurs especially when the engine is under high load or wide-open throttle. NOX formation is influenced by available excess oxygen, time, and deposit build up.

AFC significantly lowers the amount of NOX production in internal combustion engines and open flame boilers. This reduction correlates with combustion deposit removal. Carbon deposit build up in the combustion chamber causes higher compression. This directly affects the factors responsible for the formation of NOX, and supports a direct connection between NOX emissions and deposits. This connection is supported by the fact that engines using AFC treated fuel produce lower amounts of NOX. The process by which AFC inhibits the formation of NOX is a direct result of the process by which it removes existing deposits and prevents the formation of new deposits, namely through the promotion of CO2 production.

AFC affects the three main factors enhancing the formation of NOX. Fuel has a finite amount of energy, which is released through the production of CO2. AFC promotes the formation of CO2 during the combustion phase. If more CO2 or energy is produced during the combustion phase, then less is available to be released during the exhaust phase.

The difference in the amount of energy released during the two phases correlates to a temperature differential. This temperature differential, its magnitude, and cause, are important for three reasons:

Lower Exhaust Temperatures

If the temperature of the combustion phase rises due to increased CO2 production, then the temperature of the exhaust phase will go down. This denies the nitrogen molecules the high temperatures needed to form NOX compounds. Lower temperatures slow down the production of NOX by requiring more time for the reactions to take place. The greater the amount of energy released during the combustion phase and the associated lower exhaust gas temperature, the lower the rate of NOX production will be.

Shorter Heat Transfer Time

The greater the magnitude of the temperature difference, the shorter the heat transfer time becomes. Increase in heat transfer to the surrounding engine components during combustion will decrease exhaust temperature and time for the conversion of nitrogen to NOX compounds. The shorter the heat transfer time the lower the NOX emissions.

Oxygen Depletion

Increasing the production of CO2 uses up more of the available oxygen. AFC promotes the production of CO2 during the combustion phase, lowering oxygen availability for NOX reactions during the exhaust phase. Less available oxygen results in lower NOX emissions.

The combination of lower exhaust temperatures, shorter heat transfer time, less available oxygen, and the complete removal of carbon deposits cause a very significant reduction of NOX emissions.

The Effects of AFC on Low Sulfur Fuels

In the past few years, the sulfur content of diesel fuel has become a major concern due to its contribution to SOX emissions, especially SO3. When combined with water, it forms acid. This has led to legislation requiring the removal of all but .05% of the sulfur in all diesel fuel used in over the road applications as of October 1, 1993. New regulations will further lower allowable sulfur content.

Although sulfur itself does not contribute to the performance of a fuel, the fuel components removed with the sulfur to produce a low sulfur fuel do. These other fuel components have a BTU value, and give the fuel its lubricating properties. The latter is important since many engine manufacturers use the fuel itself to lubricate the fuel pump, and other engine parts, that come in contact with the fuel. These same components also provide an important portion of the total energy content of the fuel.

Low sulfur fuels have a lower BTU value, a lower lubricity factor, and present significant problems for fuel producers and users alike. In the refining process, a considerable amount of extra work is required to remove the sulfur. The process may require extensive re-tooling of the refinery, which translates into a significant cost increase for the end user. The result is a lower energy yielding fuel at a higher cost.

Cost increase is not the only problem the end user will experience. There will be an immediate drop in fuel economy of about 3 to 7%, and a considerable loss of power resulting from the lower BTU value. Because of the reduced lubricating properties of the fuel, vital engine parts will wear out more quickly. This can be noticed in as little as one or two months. The reduction in lubricity will also contribute to a loss in usable power, due to the increased friction the engine will have to overcome. Even a perfectly tuned engine will experience a noticeable drop in efficiency.

The traditional solution has been to add lubricity and anti-wear additive packages to the fuel. AFC contains a premium lubricity and anti-wear additive package, correcting the friction and wear problems.

New legislation offers another alternative. If it can be shown that a higher sulfur content fuel (.1-.2% sulfur content) can meet the emission standards of a lower sulfur fuel mandated for use in a particular area, then a waiver can be received for the use of that fuel. The benefits are that higher sulfur fuel will be easier to manufacture, less expensive to buy, and offer better fuel economy than the low sulfur fuel.

One may qualify to obtain a waiver by treating the higher sulfur fuel with AFC Fuel Catalyst. AFC will decrease the emissions of SOX by catalyzing reactions between the sulfur and minerals in the fuel, thus converting the combustion products of sulfur to harmless solid sulfur salts found in common soil and rock. A higher concentration of sulfur may therefore be present in the fuel while resulting in constant or lower SOX emissions when compared to a reference low sulfur fuel.

AFC keeps the engine clean and free of deposits, which lowers maintenance and operating costs. The lubrication oil of engines using AFC stays significantly cleaner and lasts much longer. Regardless of the type of fuel used, AFC treated fuel will perform better than non-treated fuel. The results will always be immediately evident. In the long run, the cost of AFC treated fuel will always be significantly less than the cost of using low sulfur fuel. In all applications, AFC more than pays for itself. It saves money, and enhances your bottom line.

AFC in Fuel Containing Vanadium and Sulfur

Crude oils from Alberta, Canada and Venezuela contain considerable amounts of dissolved vanadium oxides. Normal refinery practice does not provide for the removal of these vanadium oxides. In fact, a major source of commercial vanadium is derived from the fly ash from burning Canadian crude.

In an engine where there is no catalyst for the fuel combustion, unused oxygen can cause the vanadium (oxidation state of three) to be oxidized to vanadium pentoxide (V_2O_5). This V_2O_5 can be a problem in itself because it deposits as a hard coating on the surface of the combustion chamber walls. Under many circumstances, it has to be manually chiseled off.

If an engine is already damaged by vanadium deposits (V_2O_5), it is unlikely that AFC can burn off these deposits. If the deposits are carbon, adding AFC to the fuel will burn off these carbon deposits.

In addition, the presence of V_2O_5 can catalyze the transformation of sulfur dioxide (SO_2), forming sulfur trioxide (SO_3). This is important because sulfur trioxide (SO_3) and water gives the highly corrosive sulfuric acid.

Since water is one of the products of hydrocarbon combustion, much damage can occur to all metal parts of the combustion chamber and the exhaust system, resulting from the acid that is produced when vanadium is in the fuel.

The use of AFC results in the complete use of the oxygen present in combustion, leaving little or no oxygen to oxidize the mixed vanadium oxides to V_2O_5. By using up all the available oxygen to burn the fuel completely, there is little or no oxygen left over to oxidize the SO_2 to SO_3, whether V_2O_5 is present or not.

In new engines and boilers, the use of AFC will significantly diminish the formation and deposits of V_2O_5, and therefore prevent production of SO_3 and the resultant acids. This clearly and significantly diminishes engine damage caused by acidic corrosion.

As a result, engine life and overhaul cycles will be dramatically extended, while engine maintenance, down time, and overall cost of operations will be significantly reduced.

The Effects of AFC on Fuel Specifications

Data from independent testing laboratories using ASTM procedures demonstrate that AFC fuel treatment does not significantly change any of the commonly accepted fuel specifications. The data shown below are representative of AFC at the recommended 1:5000 treatment ratio in a baseline #2 diesel fuel. The data in this report is within the limits of uncertainty as specified in the reference methods.

The data in the following table confirms that AFC fuel treatment does not cause any fuel instability or significant changes in fuel specifications, which would cause the fuel to be harmful to an internal combustion engine, or any other combustion equipment. The use of AFC treated fuels will not void equipment warranties.

TEST DESCRIPTION	FINAL RESULT BASELINE	FINAL RESULT TREATED	LIMITS/* DILUTION	UNITS OF MEASURE	TEST METHOD	DATE
ASTM D-86 DISTILLATION	N/A	N/A	*1	N/A	ASTM D-86	10/06/93
Initial Boiling Point	340	344	1	Deg. F	ASTM D-86	N/A
05% Evaporated Temperature	424	420	1	Deg. F	ASTM D-86	N/A
10% Evaporated Temperature	453	452	1	Deg. F	ASTM D-86	N/A
15% Evaporated Temperature	471	469	1	Deg. F	ASTM D-86	N/A
20% Evaporated Temperature	485	483	1	Deg. F	ASTM D-86	N/A
30% Evaporated Temperature	509	509	1	Deg. F	ASTM D-86	N/A
40% Evaporated Temperature	528	528	1	Deg. F	ASTM D-86	N/A
50% Evaporated Temperature	548	548	1	Deg. F	ASTM D-86	N/A
60% Evaporated Temperature	565	565	1	Deg. F	ASTM D-86	N/A
70% Evaporated Temperature	584	582	1	Deg. F	ASTM D-86	N/A
80% Evaporated Temperature	606	604	1	Deg. F	ASTM D-86	N/A
90% Evaporated Temperature	633	631	1	Deg. F	ASTM D-86	N/A
95% Evaporated Temperature	659	656	1	Deg. F	ASTM D-86	N/A
End Point	673	672	1	Deg. F	ASTM D-86	N/A
% Recovery	97.9	97.9	0.1	Vol. %	ASTM D-86	N/A
% Residue	1.6	1.5	0.1	Vol. %	ASTM D-86	N/A
% Loss	0.5	0.6	0	Vol. %	ASTM D-86	N/A

TEST	FINAL RESULT BASELINE	FINAL RESULT TREATED	LIMITS/* DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECH.
Acid Number	0.002	0.002	0.002	mg KOH/g	ASTM D-664	10/06/93	DD
Ash Content, Routine	<0.001	<0.001	0.001	Wt%	ASTM D-482	10/07/93	DD
Gross Heating Value	19201	19110	1	BTU/lb	ASTM D-240	10/04/93	QE
Sulfur by X-Ray Spectro-photometry	0.039	N/A	N/A	N/A	N/A	N/A	N/A
N/A	0.039	0.005	Wt%	ASTM D-4294	10/05/93	PCW	N/A
Pour Point	15	20	-60	Deg. F	ASTM D-97	10/07/93	MQ
Cloud Point	14	18	-40	Deg. F	ASTM D-2500	10/07/93	MQ
Gravity, API @ 60 Deg F	31.9	31.9	-20	Deg. API	ASTM D-287	10/04/93	PCW
Conradson Carbon	0.04	0.04	0.01	Wt%	ASTM D-189	10/02/93	QE
Copper Strip Corrosion	1a	1a	N/A	N/A	ASTM D-130	10/02/93	PCW
Flash Point, PMCC	142	142	70	Deg. F	ASTM D-93	10/05/93	QEW
Cetane Number, Neat	43.6	44.3	20	Cetane #'s	ASTM D-613	10/31/93	FB
Water, Karl Fischer	65	49	1	Ppm	ASTM D-1744	10/08/93	DD
Accelerated Stability	0.54	0.54	N/A	mg/100ml	ASTM D-2274	10/08/93	DD
Particulate	6.9	5.7	0.1	mg/l	ASTM D-2276	10/08/93	D
Viscosity @ 100 Deg F	3.7	3.70	0.01	CSt	ASTM D-445	10/07/93	DE

The enclosed tables describing the effect of AFC on fuel specifications are within the limits of uncertainty, as specified in the reference methods. There is no significant change in fuel specifications. The differences in the test values will not affect fuel performance in the field to any noticeable degree.

Pour Point and Cloud Point

Pour Point

The pour point is the lowest temperature at which a petroleum product will begin to flow. Pour point is measured at intervals of 5°F (-15°C). This interval gives a range in which to account for error inherent in the measuring procedure. A sample with a pour point of 10.5°F (-12°C) and a sample with a pour point of 14.5°F (-9.7°C) would be labeled as having a pour point of 15°F (-9.4°C). Even with the 4° difference, they would be considered the same. However, a sample with a pour point of 15.5°F (-9.2°C) would be labeled as having a pour point of 20°F (-6.7°C), even though it is only 1° higher than the 14.5°F (-9.7°C) sample mentioned before. Due to experimental and operator error, sample variations of one interval are not considered significant. Since the measured values for the two samples are only one interval apart, the difference is not significant.

Cloud Point

The cloud point is the temperature at which wax crystals begin to form in a petroleum product as it is cooled. Cloud point is measured at intervals of 2°F (-16.7°C). An example similar to the one used illustrating the pour point procedure applies here. Differences of one interval are not considered significant. Wax crystals depend on nucleation sites to initiate growth. The difference in the cloud points of the two samples is explained by the fact that any fuel additive will increase the number of nucleation sites, which initiate clouding. A change in temperature at which clouding starts to occur is therefore expected upon addition of any additive. The difference between the cloud point values for the two samples is not abnormal and is not significant.

Combustion Catalyst Treatment Ratios

The AFC combustion catalyst compound is the deposit control and combustion surface modifier, which acts as a catalyst, breaking down carbon deposits. The deposits are reduced through a process called de-carboxylation, which is the release of a carbon atom in the form of CO_2.

The relatively cool surface temperature of the deposit layer restricts de-carboxylation from happening naturally in an internal combustion engine. The catalyst reduces the temperature needed for de-carboxylation from about 600°C (1112°F) to about 200°C (392°F). It enables the chemical reaction to occur on the cooler surface of the deposits.

The interaction of the catalyst with the exposed surface of the deposits causes the release of a water molecule and a carbon molecule in the form of CO_2. The deposit surface re-oxidizes to a carboxyl state and continues interacting with the catalyst molecules.

The effectiveness of AFC in removing carbon deposits is related to the surface area and mass of the deposits, the amount of new deposit material being formed during combustion, and the amount of catalyst present. Results will be different for each combustion chamber because of its unique history of deposit buildup. However, due to the similarity in basic chemical reactions, the end result will be the same despite any differences.

Once an old engine is clean, the minimum amount of AFC needed is the amount required to inhibit new deposit formation. A new engine needs only this minimum amount to remain clean, and a dirty engine will not get any worse. The exact amount in each case depends on the size of the combustion chamber and the fuel being used. It ensures zero new deposit formation, and the complete removal of all old deposits.

The optimum amount to use in a dirty engine is the amount necessary to inhibit new deposit formation plus completely saturate all exposed surfaces of existing deposits. Excess amounts of catalyst beyond the surface saturation point, will not speed up the deposit removal process.

The concentration of the active ingredient has been calculated such that the majority of the dirty engines in operation will receive a sufficient amount of combustion catalyst required for total deposit surface saturation.

The recommended treatment ratio for AFC is 1:5000. Concentrations higher than 1:2500 are not recommended. Concentrations of 1:100 may begin to produce perceptible changes in fuel specifications.

- 1 ounce of AFC treats 40 gallons of fuel.
- 1 gallon treats 5000 gallons.

AFC - An Alternative Technology

An average reduction of five 5-10% in the consumption of petroleum based fuels, and a very significant reduction of emissions, is possible without redesigning combustion engines, turbines, and burners, or retrofitting refineries.

AFC contains a multi-component combustion catalyst that promotes the removal of engine deposits, especially those in the combustion chamber. While removing deposits, AFC treated fuel burns cleaner and more completely, thus eliminating the formation of new deposits. Old engines become clean, and new engines stay clean. Initially, the use of AFC treated fuel will often show reductions in fuel consumption far greater than the average 5-10%. The reduction of emission will increase with the removal of the existing deposits.

In addition, the use of AFC treated fuel will significantly lower equipment operating and maintenance costs while extending engine life. There is less wear on the engine parts, and engine oil stays cleaner much longer. When disassembling an engine, a simple wipe down with a shop cloth will show that the parts look as good as new, often with all the serial numbers clearly readable, and machining marks still clearly visible.

AFC is extremely cost effective technology. This complete additive package improves fuel consumption and reduces emissions. It extends engine life, decontaminates and cleans the total fuel system, dissolves tank sludge, and lowers operating and maintenance costs, while enhancing your bottom line.

AXI INTERNATIONAL WARRANTY - LIMITED WARRANTY

AXI International makes every effort to assure that its products meet high quality and durability standards and expressly warrants the products described herein, against defects in material and workmanship for a period of one (1) year from the date of purchase. This warranty is not intended to supplant normal inspection, care and service of the products covered by the user, and shall not obligate AXI International to provide free service during the warranty period to correct breakage, maladjustment, or other difficulties arising out of abuse, misuse, or improper care and maintenance of such products. Our express warranty is subject to the following terms and conditions:

This warranty shall only extend to and is only for the benefit of original purchaser(s), or end customer(s) who use the products covered hereby. This warranty is not an on-site warranty. Travel requests will be at the discretion of AXI International. Defective systems and ancillary products will require a return authorization number and shipping to AXI International's Factory in Fort Myers, FL.

Any warranty claim received by AXI International after one (1) year from the date of purchase will not be honored even if it is claimed that the defect occurred prior to one (1) year from the date of purchase. Claims outside of this one (1) year period, and for claims not listed within, payment, repair, or service will be awarded at the discretion of AXI International.

This warranty shall not apply to products (1) which have been tampered with, altered or repaired by anyone other than AXI International without the express prior written consent of AXI International (2) which have been installed improperly or subject to misuse, abuse, accident, negligence of others, improper operation or maintenance, neglect or modification, or (3) which have had the serial number altered, defaced or removed.

The liability of AXI International under this warranty is limited to the repair or replacement of the defective product. AXI International assumes NO LIABILITY for labor charges or other costs incurred by any purchaser incidental to the service, adjustment, repair, return, removal or replacement of products. AXI INTERNATIONAL ASSUMES NO LIABILITY FOR ANY GENERAL, SPECIAL, INCIDENTAL, CONSEQUENTIAL, CONTINGENT OR OTHER DAMAGES UNDER ANY WARRANTY, EXPRESS OR IMPLIED, AND ALL SUCH LIABILITY IS HEREBY EXPRESSLY EXCLUDED. AXI INTERNATIONAL MAKES NO WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, WITH RESPECT TO THE PRODUCTS COVERED BY THIS WARRANTY POLICY, EXCEPT AS EXPRESSLY PROVIDED FOR HEREIN. NO EMPLOYEE, AGENT, REPRESENTATIVE OR DISTRIBUTOR IS AUTHORIZED TO MAKE ANY WARRANTY ON BEHALF OF AXI INTERNATIONAL OTHER THAN THE EXPRESS WARRANTY PROVIDED FOR HEREIN.

AXI International reserves the right at any time to make changes in the design, material, function and specifications of its products. Any such changes shall not obligate AXI International to make similar changes in such products that were previously manufactured.

Warranty Claim Procedure

To make a claim under this warranty, please call AXI International at +1-239-690-9589 or +1-877-425-4239, and provide: Name and location where unit was purchased, the date and receipt of purchase, model number, serial number, and a detailed explanation of the problem you are experiencing. The Customer Service Representative may, at the discretion of AXI International, arrange for a Field Engineer to inspect your system. If the inspection discloses a defect covered by its limited warranty, AXI International will either repair or replace the defective parts or products. AXI International assumes no liability, if upon inspection, AXI International or its representative determines that there is no defect or that the damage to the system resulted from causes not within the scope of this limited warranty.

For service and sales, please contact AXI International:

AXI International
5400 Division Drive, Fort Myers, FL 33905
Phone: +1-877-425-4239
Fax: +1-239-465-0881

Web: www.axi-international.com

Email: support@axi-international.com

TECHNICAL ASSISTANCE AND ORDERING

Please write, fax, email or call:

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Email: info@axi-international.com
Internet: www.axi-international.com

AXI International's innovative fuel solutions restore, maintain, and improve the quality and stability of diesel fuel wherever it is used or stored. AXI's product range includes automated enclosed fuel maintenance systems, mobile fuel polishing systems, compact intelligent fuel maintenance systems, fully integrated day tank systems, fuel transfer systems, fuel conditioners, Tier 4 compliant fuel catalyst, fuel sampling, and fuel testing.

- Mission Critical
- Fuel Storage
- Marine
- Government
- Military
- Mining
- Agriculture
- Power Gen
- Railway
- On-Road

AXI also designs, engineers, and manufactures custom built fuel system solutions – working side by side with its customers, architects, engineering firms, and facility management companies to create innovative, fully-automated intelligent fuel optimization and maintenance systems.

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