POSITIVE ENVIRONMENTAL IMPACTS DERIVED FROM DIESEL FUEL FILTRATION

BASIS FOR CARBON FOOTPRINT CALCULATIONS

Strategy: reduction of diesel particle contamination with Premium FMS filtration systems

Annual consumption: 1'000,000 Gallons (diesel)

Diesel fuel savings: **15%**

Annual reduction of GHG emissions (CO_{2e}): 1,527.25 metric tons of greenhouse gases (GHG) = Carbon dioxide equivalent (CO_{2e}) = Carbon Footprint

Equivalent in trees planted per year: 127,270.63 trees

Automatic table for CO_{2e} calculation:

	Gallons / Year	Liters / Year		
Consumption =	**1,000,000.00**	**3,785,000.00**		
Est. savings =	**15.00%**	**567,750.00**	(**Source:** Power Loss)	**Appendix 1**
$EF_{diesel\ fuel}$ =	2.69	CO_{2e} / liter	(**U.S. Federal Register 2010**)	**Appendix 2**

$CO_{2e} = (C * EF_{diesel\ fuel}) / 1000$	(**Source: TARAM 2007**)	**Appendix 3**

Where:

CO_{2e} = Metric tons CO_{2e}

C = Liters of fuel saved

$EF_{combustible}$ = Emission factor for diesel = 2,69 kg CO_{2e} / liter

CO_{2e} (Ton) =	**1,527.25**	**Metric Tons of CO_{2e}**

1 tree / year captures 12 kg of CO_2 (**Government Mexico**)

83.33 trees / year compensate 1 metric ton of CO_2 — **Appendix 4**

127,270.63	**trees planted to compensate for the total Ton CO_{2e} reduction**

ENVIRONMENTAL CONCLUSIONS: TECHNICAL EXPLANATION

1. The use of Premium diesel (ultra-clean and ultra-dry) with ISO 4406 cleanliness codes in **optimal parameters 11/8/7 or better**, has evidenced a 15% savings (@The Americas) in diesel fuel consumption of engines, which represents to stop emitting to the environment 1,527.25 metric tons of emission gases or CO_2 per million gallons. Using the calculated factor in Mexico of 83.33 trees per metric ton of CO_2, this would be interpreted as the equivalent of planting 127,270.63 trees per year.

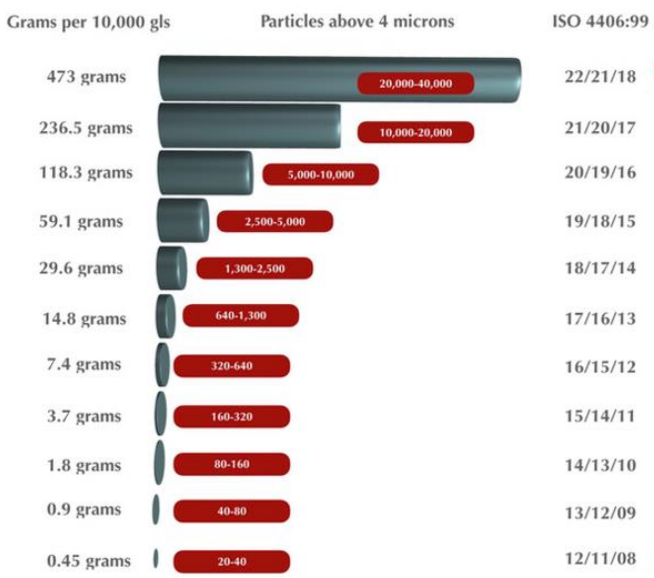
2. Based on an annual consumption of 1'000,000 US gallons and contemplating an average code of 22/21/18, which represents 473 grams of contamination for every 10,000 gallons of diesel, **47,300 grams of contamination would be removed from the diesel annually**. If on average an estimated 10% of this contamination passes into the engine lubrication system through the rings in the compression chambers, it would mean that at least 4,730 grams would NOT deteriorate the engine oil, causing oil filter saturation, premature oil deterioration and high internal wear of the engines in the first instance. And the remaining 42,570 grams of particles would not clog OEM on-board engine diesel filters, injection systems (injectors, injection pumps, etc.), aftertreatment systems, catalytic converters, etc. without leaving aside all the air pollution and environmental contamination.

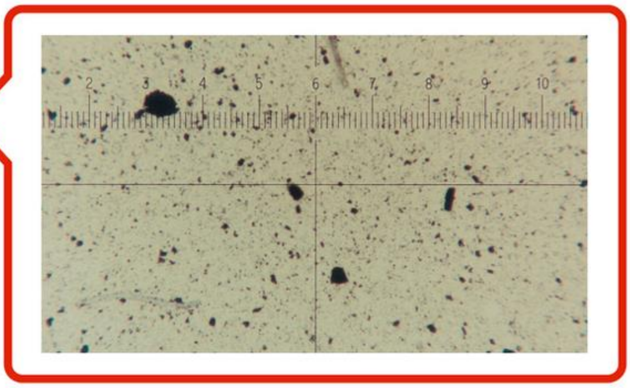
3. An engine consuming 10 gal/h will burn 10,000 gallons of fuel in 1,000 hours of work and will have performed an average of 4 oil changes every 250 hours of operation. Now, if an ISO 22/21/18 diesel contains 473 grams in 10,000 gallons of volume, therefore, 118.25 grams will be burned every 250 hours or oil interval, 1.5 grams contaminating 10 gallons of oil is enough to increase fuel consumption by 3% and generate wear and premature compression loss. This same engine consuming 11/8/7 fuel will burn less than 0.06 grams every 250 hours/oil change interval. This means that "**Oil life extension is the consequence of engine life extension**". **Engine oil life is directly related to the quality/contamination of the diesel fuel we use**.

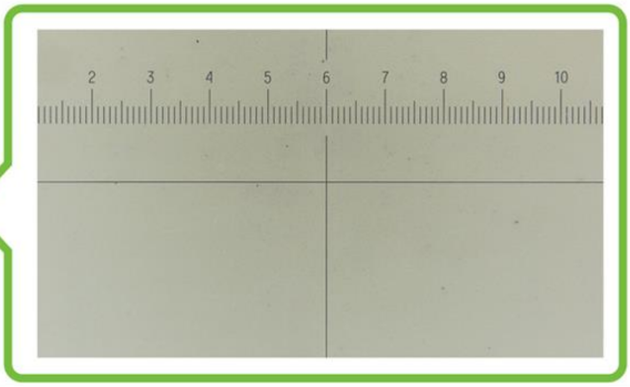
If an operation decreases 15% of its annual fuel consumption as a benefit derived from the use of a Premium Diesel (ultra-clean and ultra-dry), in 1 million gallons, the positive environmental impact would be equivalent to having planted 127,270 trees. It will stop expelling 1,527.25 metric tons of emission gases and 47,300 grams of polluting particles of suspended matter into the air (PM).

VISUAL COMPARISON OF CLEANLINESS IN ISO 4406 CODES

DIESEL 22/21/18 (average contamination) VS DIESEL 12/11/08 (premium ultra-clean)





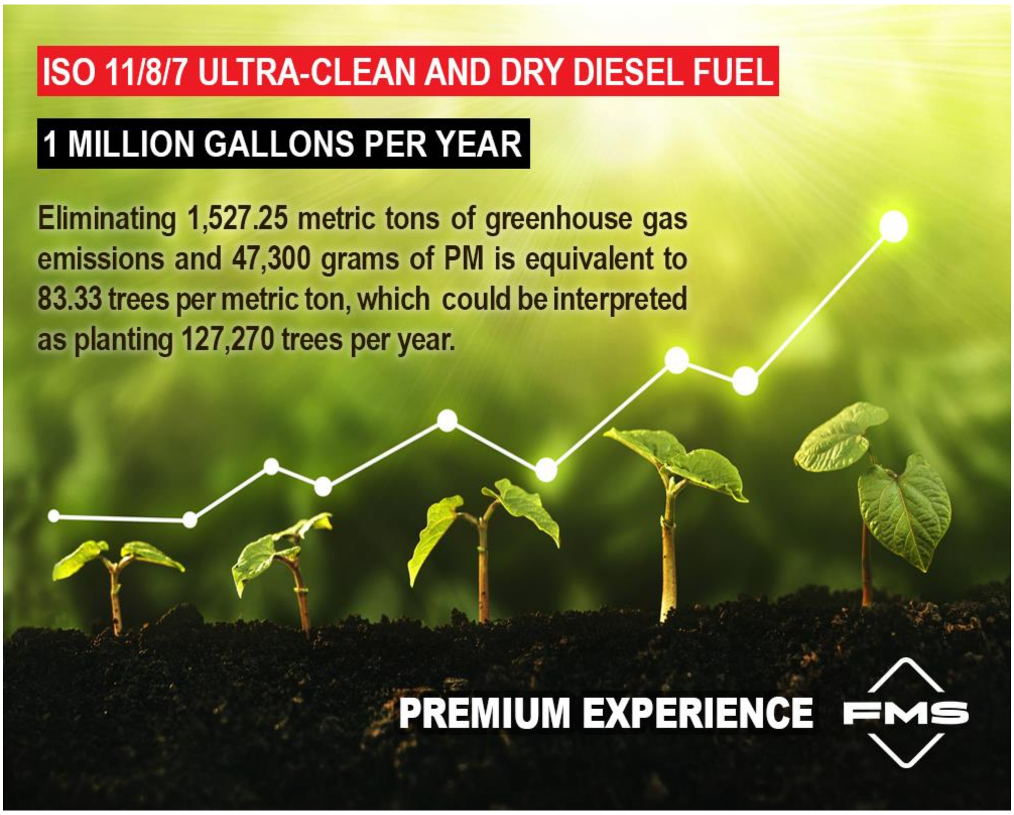


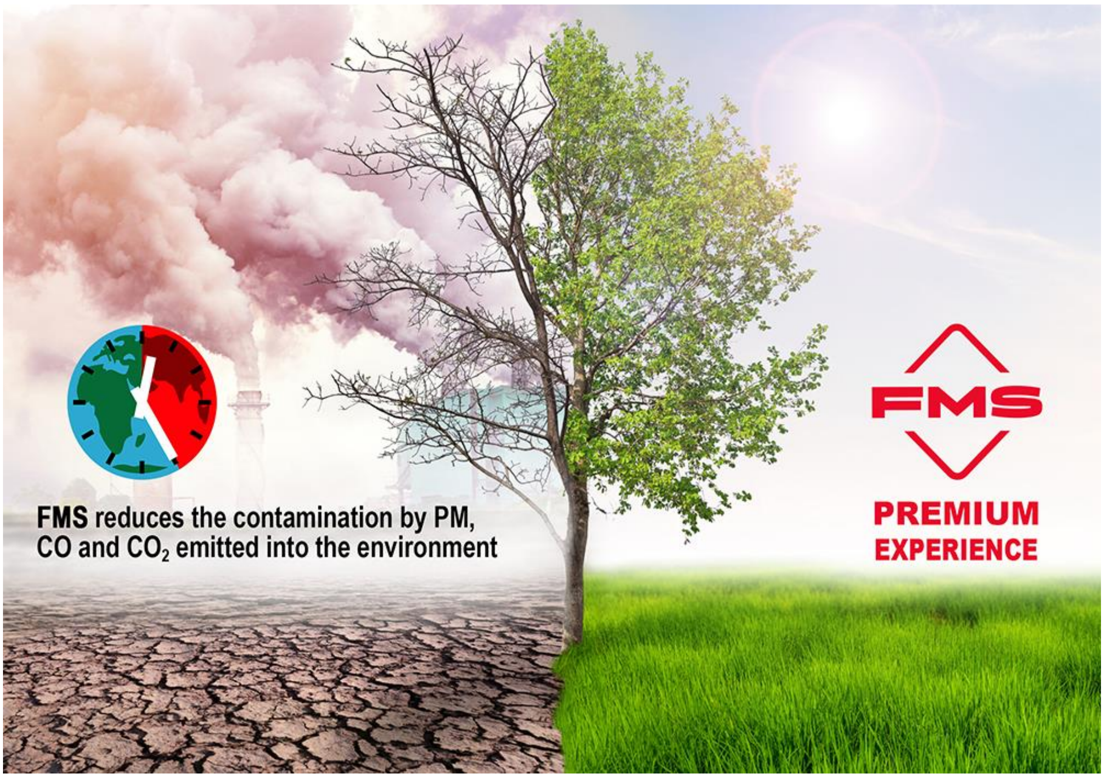
POLLUTANTS PRESENT IN EMISSIONS

COMBUSTION

CO2 →	Not a pollutant gas →	Natural gas, main source of food for plants →	Imbalance = Greenhouse effect →	Decrease CO2 emissions, or plant more trees
CO →	Pollutant gas →	Produced by incomplete combustion →	Considered a harmful, deadly (poisonous) gas →	Eliminated with clean diesel and technologies over Tier IV or Euro 5
SOOT →	Deadly air pollutant →	Produced by contaminated diesel →	A threat to the environment, and harmful to human health →	Eliminated with clean diesel and technologies over Tier IV or Euro 5

ENVIRONMENTAL BENEFITS SUMMARY





APPENDIX 1

4 STAGES OF POWER LOSS

1 - BAD DOSAGE

The injection systems require an ISO 11/8/7 diesel for dosing the fuel optimally. The wrong dosing of the injector due to the presence of particles is synonymous with loss of power and therefore **greater consumption of fuel up to 5%**.

2 - COMPRESSION LOSS

The particles in the combustion chamber will cause premature wear in the cylinders, generating premature loss of compression which becomes loss of power and **greater fuel consumption** over the useful life of the engine of up to **7%**.

3 - CONTAMINATED LUBRICANT

The lubricant oil contaminated with particles raises friction and temperature, causing up to **2-3%** loss of power and **greater fuel consumption**.

4 - PREMATURE SATURATION OF DPF

The pressure drop of particulate filters causes **up to 2% of loss of power** and **greater fuel consumption** due to burnt particles clogging.

CONCLUSION

When an engine experiences a loss of compression, power and overall engine performance are affected, leading to a decrease in engine efficiency and an increase in fuel consumption. The magnitude of the increase in fuel consumption can vary from case to case and would require a specific analysis of the engine in question. It is important to keep in mind that compression loss is not the only factor affecting fuel consumption in an engine. Other aspects such as proper maintenance, fuel quality and operating style can also influence performance and fuel consumption.

The use of an **ISO 11/8/7** (ultra-clean and ultra-dry) diesel prevents the 4 problems described, so a clean environment in the engine will promote its optimum performance, delivering its maximum power, with a benefit of up to a **15% decrease in its fuel consumption**.

APPENDIX 2

The joint regulation by USA's Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration (NHTSA) established a final rule for *Greenhouse Gas Emission Standards* on May 7, 2010 (source -page 7). The agreed emission factor is **10,180 g of CO_2 per gallon of diesel consumed** (source), equivalent to **2.69 kg per liter of diesel** (Federal Register 2010).

APPENDIX 3

TARAM: *Tool for Afforestation and Reforestation Approved Methodologies*, developed in 2007 by the World Bank's BioCarbon Fund, is a calculation tool that estimates ex ante emission reductions according to afforestation and reforestation methodologies.

The carbon footprint calculation consists of applying the following formula:

GHG emissions (t CO_2e) = Activity data x Emission factor

Where:

- The **ACTIVITY DATA** is the parameter that defines the level of the activity generating **greenhouse gas (GHG)** emissions. For example, the amount of diesel used in an internal combustion engine.
- The **EMISSION FACTOR (EF)** is the amount of GHG emitted per unit of the "activity data" parameter. These factors vary depending on the activity concerned. For example, in relation to the activity described above (diesel consumption in internal combustion engines), the emission factor is **2.69 kilograms of CO_{2e} per liter of diesel** (Appendix 2).

  NOTE: It is important to note that the emission factor per diesel may vary according to the exact composition of the diesel fuel used, the combustion conditions, and according to the regulations and emission standards applicable in each country or region.

As a result of this formula, we will obtain a given amount (kilograms, tons, etc.) of **carbon dioxide equivalent** (CO_{2e})

> **NOTE**: The term **carbon dioxide equivalent** (CO_{2e}), is the unit used to display the results in terms of GHG emissions. The gases that the Kyoto Protocol indicates as the most responsible for the greenhouse effect and that contribute to global warming are: carbon dioxide (CO_2), methane (CH_4), nitrogen oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6) and, since COP 181 held in Doha at the end of 2012, nitrogen trifluoride (NF_3). **However, CO_2 is the GHG that has the greatest influence on global warming**, which is why GHG emissions are measured in terms of this gas. Source: ***LCA4Regions, Interreg Europe***, *October 2020, page 5 (LINK), by the European Union- European Regional Development Fund.*

APPENDIX 4

The exact amount of carbon dioxide (CO_2) captured by a tree in a year can vary according to different factors (source), such as tree species, size, geographic location and environmental conditions. However, according to scientific studies, a mature tree can capture approximately 10 to 30 kilograms of CO_2 per year (source).

The National Commission of Natural Protected Areas of the Government of Mexico for its calculations establishes (source) that **a single tree captures an average of 12 kilograms of carbon dioxide (CO_2) in a year** and exhales enough oxygen for a family of 4 people. Also, it determines that one hectare of trees can absorb 6 tons of carbon dioxide per year.

Other bibliographic sources:

- QSI Certification: ISO 14064-1 CARBON FOOTPRINT VERIFICATION (source)

- The Quint, India: How Many Trees Does It Take to Absorb CO2? (source)

- According to the United Nations Framework Convention on Climate Change (UNFCCC) (2011), climate change is the result of human-induced greenhouse gas (GHG) emissions that increase atmospheric GHG concentration and change global weather patterns. In the United States, the Environmental Protection Agency (EPA) (2021a) estimates that 80% of GHG emissions in 2019 were from carbon dioxide (CO_2), primarily from fossil fuel use (source, page 3)