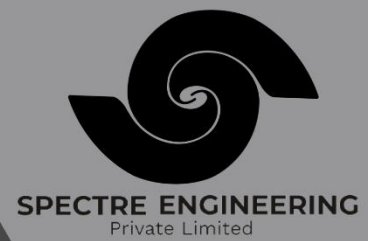


# CAVIBLEND

## Fuel – Water Emulsion System



### Introduction

‘CaviBlend’ is a new system that blends fuel (diesel / LDO / middle oils) with water, while performing the following functions simultaneously-

1. Grinding the liquids to a drop size of 5 – 10 microns.
2. Homogenizing two or more immiscible liquids by breaking their long molecular chains and adding water clusters, without any emulsifiers / surfactants / additives.
3. Heating and sterilizing the emulsified liquids up to 80°C, with automatic temperature control.

The operating principle of CaviBlend is based on the destruction of high molecular weight polymeric linkages of hydrocarbon compounds, and subsequent blending with water clusters to produce homogenous emulsions. In the process, fuel and water are intensively mixed, crushed and finely dispersed as emulsions. CaviBlend brings structural and molecular changes in the agglomerates and destroys organic and mineral impurities.

The proof of any technology is in its practical working model and such blending systems have been successfully running in Europe for more than 20 years now.

CaviBlend has a wide range of applications in boilers, kilns and furnaces. In industrial plants which are fired by diesel / LDO / middle oils, the following can be achieved by installing a CaviBlend system -

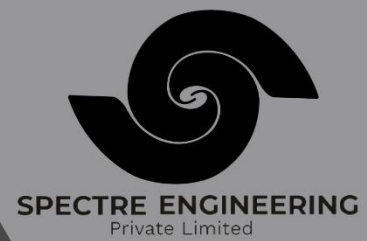
1. Fuel saving of 15-20%, with a pay-back period of 6 - 18 months.
2. Huge environmental benefits, due to 50-60% reduction in harmful emissions.



*A model of CaviBlend*

# CAVIBLEND

## Fuel – Water Emulsion System



### Fuel Economy

CaviBlend can save fuel –

- By mixing 25% water with 75% diesel.
- By mixing 25% water with 75% LDO / other middle oils.

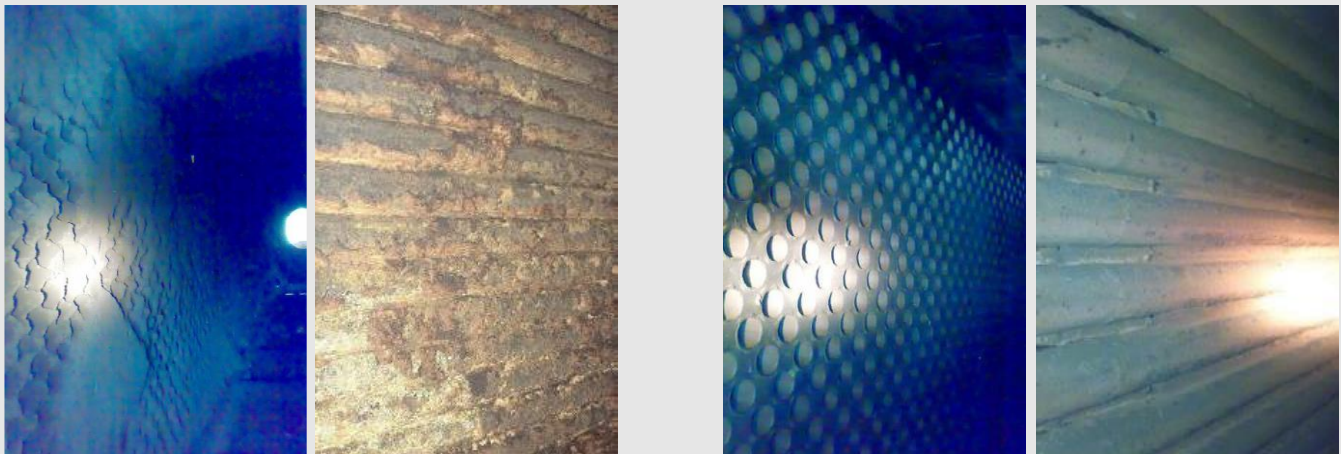
On first look, it may seem that the heat value of the fuel-water mix should reduce proportionately, but in reality, there is a minimum of 15% fuel saving due to the following reasons –

- Complete burning of the fuel, due to the micro-explosion of water clusters during combustion.
- The H<sup>+</sup> and OH<sup>-</sup> ions (derived from the added water) will also participate in the combustion process.
- The flame length is reduced, while the flame width is increased. Hence, the exposed surface area is larger, leading to an improved combustion efficiency.

### *Micro-explosion of fuel-water emulsion*

The micro-explosion phenomenon of fuel-water emulsion has a huge impact on the combustion process. The suspended water particles in the emulsion fuel reach their super-heated stage faster than the fuel alone. This creates a vapour expansion break-up (spontaneous steam expansion) during combustion, forming very fine particles and leading to lower levels of soot deposition on the boiler heat exchanger.

Due to the reduction in size of the fuel-water emulsion particles, the surface area of the fuel in contact with air is increased, leading to a faster rate of reaction. This increase in the area of contact between fuel and atmospheric oxygen is equivalent to spraying of fuel at a nozzle pressure of 150 – 300 kg/cm<sup>2</sup>.



*Soot deposition on boiler heat exchanger before (left) and after (right) firing fuel – water emulsion*

# CAVIBLEND

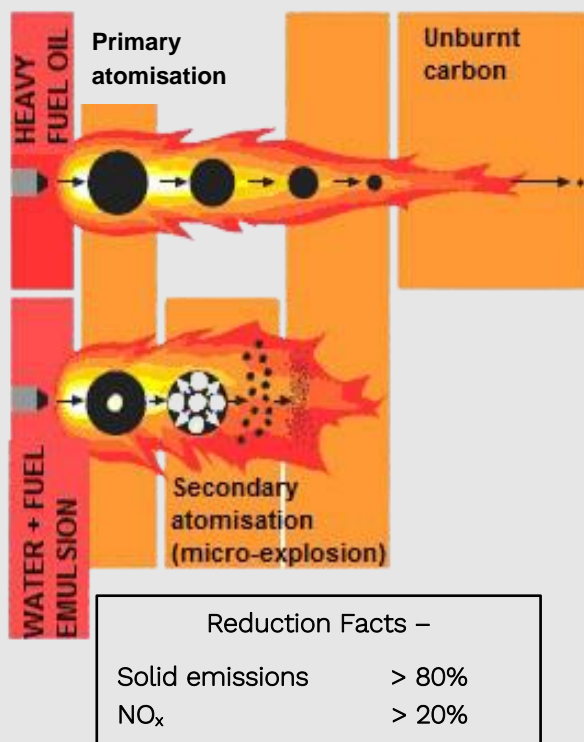
## Fuel – Water Emulsion System

### Reduction in exhaust emissions

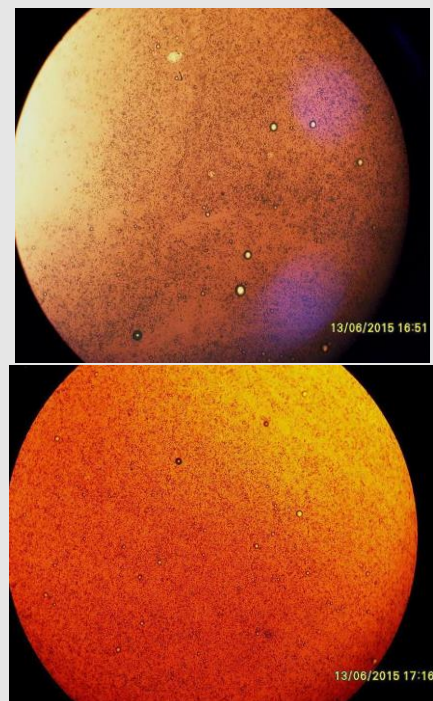
Micro-explosion of water clusters will ensure that each & every particle of the fuel-water mix is burnt completely, leading to a reduction in the following harmful emissions–

- Un-burnt hydrocarbons (soot) will reduce by 70 – 80%.
- Half-burnt carbon (CO) will reduce to almost zero.
- Smoke and particulate matters will reduce by 60 – 70%.
- NO<sub>x</sub>, SO<sub>x</sub> and CO<sub>2</sub> will reduce by 20 – 30%.

High latent heat of water particles during combustion will lower the local temperatures, resulting in significant reduction of NO<sub>x</sub> emissions. Reduced levels of soot and particulate matters are due to better mixing and enhanced atomization caused by micro-explosions, lower flame temperatures and rapid vaporization of water. Lower levels of carbon monoxide and un-burnt hydrocarbon are once again due to the micro-explosion phenomena, as it leads to complete combustion.



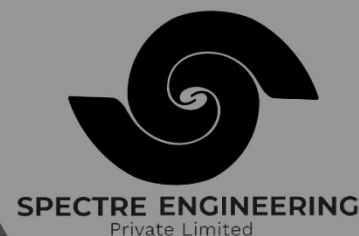
*Schematic diagram that showing secondary atomization and enhanced air-fuel mixing*



*Microscopic images of oil particle before (top) and after (bottom) CaviBlend activation*

# CAVIBLEND

## Fuel – Water Emulsion System



Since hydrocarbons are completely combusted, the quality of smoke improves.



*Smoke from fuel combustion*



*Smoke from fuel – water combustion*

Hydrocarbons of fuel oil are in a bound condition. When the fuel droplets are ignited, the combustion process begins on the active side of each large polymer unit – a cluster. In this case, the combustion of paraffin or sulphur will be incomplete, which leads to toxic emissions. Un-burnt fuel oil is deposited on the surface of heat exchangers, causing a reduction in the boiler efficiency.

In CaviBlend, the fuel is finely ground and uniformly homogenized. This will lead to a number of positive changes affecting its combustion quality. The fuel's polymer chains are broken down and a large number of molecules enter into the oxidation process quickly. The de-coupled molecules form free radicals, having a much greater ability to react than closed molecules.

The water molecule chains are also destroyed, and the water passes into a fine state with partial formation of free  $H^+$  and  $OH^-$  ions. These ions participate in the combustion process considerably, forming unstable and oxidizable compounds with free radicals of fuel. Sulphur & paraffin form surface-active compounds, aiding the process of forming naturally emulsified mixtures of micro particles.

Since no emulsifiers are used in CaviBlend, the fuel-water mix has to be combusted on-line, to prevent their separation after some time. The existing burner system can be used, after adjusting the viscosity and temperature of fuel-water emulsions. The type of burner has little impact on the performance of CaviBlend.

**Spectre Engineering is introducing this innovative technology to India, by importing the key components from Europe and creating the entire system as per your specific needs.**

### Spectre Engineering Private Limited



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