EMULSION POWER S.r.l. is a forward looking energy company concerned with optimal use of fuels in order to benefit the environment and reduce economic cost while adhering to legislative regulations.
Emulsion Power is a new company providing emulsified fuel technology, able to supply both stabilised emulsions (‘stable’ emulsions) for distribution and ‘on-demand’ emulsions, which are made and consumed soon after with no appreciable storage time.

With the know how and the trade secrets of the Emulsion Power group we have achieved a high performance union of chemical additives and advanced mixing systems,

This synergy allows to insert different amounts of water in the classical energetic substances (stable emulsion with diesel, on demand emulsion with : HFO, DIESEL, VEG OIL), allowing significant environmental and economic benefits.
EMULSION POWER S.r.l. is composed by:
- RINALDI PETROLI S.r.l.: company in the energy sector since 1985
- UNISERVICE S.r.l.: company expert in business practices

BOARD MEMBERS:
- Rinaldi Cesare
- Pagliuca Lorenzo
- Rinaldi Davide

Emulsion Power S.r.l. invests in research and development through its partner ACL (Additive Chemical Limited, group Emulsion Power) working in exclusive for Emulsion Power S.r.l.:
- Alex Psaila – Chemical director
- Peter Moore – Engineer director

Emulsion Power S.r.l. is member of: CONFIN INDUSTRIA
EMULSION POWER & ACL
Research and Development

Emulsion Power has personally developed and tested the key points necessary to provide a competitive product on the market:

- **Specific Additives (ACL Series):** The connection between molecules of fuel and water must be as strong and durable as possible. Only after long studies is possible to get to the good balance for each fuel in different operating conditions.

- **Software:** The brain of the plant, with operative parameters and the correct timing of the mixing phases have been developed in order to optimize the production cycle.

- **High shear mixers:** The device in which effectively happens the union between water and fuel, have been studied to get to the smallest dimensions of the emulsion droplets (less than 1 micron), managing the production flow rate.

- **Plant Layout:** Emulsion Power has developed the layout of the entire plant, in order to have a compact and efficient production site.
The Emulsion Power/ACL team has a great experience in the petrochemical, chemical and engineering sectors with regards to the emulsions. This experience, collected since 1999 has led to the creation of Emulsion Power S.r.l. that has successfully tested and developed the technology, entering into the market in 2012 as an expert and reliable partner.

Test performed during the years:
- Trucks
- Industrial boilers
- Civil boilers
- Power generators
- Marine engines
- Certified environmental test
- Certified laboratory test
- Government authorizations
- Turbines

- Water/diesel emulsion
- Water/HFO emulsion
- Water/Veg oils emulsion
**Emulsions:**
The simple and inexpensive way to reduce pollution and costs

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>No changes are necessary to the engine and burners</td>
<td></td>
</tr>
<tr>
<td>Can be directly injected in engines or boilers</td>
<td></td>
</tr>
<tr>
<td>Equipment installed at the reseller or final client</td>
<td></td>
</tr>
<tr>
<td>Excise duty reduced for use in road transport and for heating (ITA, FR)</td>
<td></td>
</tr>
<tr>
<td>It is used as a common fuel</td>
<td></td>
</tr>
<tr>
<td>High performance additives - ACL SERIES -</td>
<td></td>
</tr>
<tr>
<td>Improves engine and burners cleanliness</td>
<td></td>
</tr>
</tbody>
</table>

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Emulsion: Ecological Fuel

From the data of the trials carried out it was observed that replacement of the diesel fuel with the emulsion tends to cause a measurable decrease in emissions of carbon monoxide (CO), nitrogen oxides (NOx) and, above all, of the particulate matter (TPM).

REDUCTION OF POLLUTION:

- SMOKE: -80%
- PM: -60%
- PM10: -40%
- NOx: -20%
- CO: -5%
The research carried out over the years have led us to develop a high performance emulsions.

The emulsion produced using our technology can be used without problems on heavy goods vehicles “heavy duty”, trains, generators and for heating use in boilers or ship engines with stable or on-demand emulsions.

On-road
- Public transport (buses)
- Civil amenities (garbage trucks, ...)
- All Heavy duty

Off-road
- Locomotives
- Marine engines
- Power generation
- Construction equipment and mining
- Domestic and industrial urban heating

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Emulsion Fuels Standards

- **French** Specification 'Arrete du relatif aux caracteristiques des emulsions d'eau dans le gazole', published in the Journal Officiel de la Republique Francaise. An AFNOR specification can be located on the AFNOR site under NF M15-021 Fevrier 2002 Carburants - Carburants pour moteur diesel (gazole) - Caracteristiques des emulsions d'eau dans le gazole (EEG).


- CUNA standard (For automotive use) (NC 637-01 Dec 2003) is tabulated below.


- **Israel** Standard: SI 5937 [based on CWA 15145:2004]

- **NC Number for stable emulsion**: 38249097-99-S098 or S099
EMULSION CATEGORIES

• **STABLE EMULSION:**
  – Diesel emulsion:
    • Automotive
    • Trains
    • Machines
    • Boilers

• **ON-DEMAND EMULSION :**
  – Diesel, HFO or Vegetable oil:
    • Boilers
    • Power generators
    • Ship engines
On-demand emulsion: E-Box

• The product “emulsion” ON DEMAND consists in mixing the component of water with the desired fuel immediately prior to combustion by using very little % of dedicated ACL additive series (between 0.1% to 1.2%).

• With this method the emulsified product is not stable for a long time, but increases the % of H₂O that can be added in the product (more than 25% of H₂O), using less additive so that costs and emissions are drastically reduced.

• We can declare that it can be considered a real method to reduce harmful emissions leading to a drastic reduction of management and fuel costs, differently from common filtration systems.

E-BOX ON DEMAND is installed between the fuel tank and the engine/boiler served with fuel. The device must be powered by deionised water in the % desired; Emulsion Power produces various models of E-Box according to the needs of the user.
On-demand emulsion: E-Box series

The “E-box” series can emulsify water with different fuels:
• Diesel
• Heavy oils: BTZ, ATZ, HFO380, ...
• Vegetable oil (Palm oil; Rapessed oil)
• Other fuel

The E-Box on demand is ideal for:
• Power generator
• Turbine
• Marine engines
• Large boilers
• Big engines

Our range of E-Box products changes with the product to be emulsified and on the flow rate required. Starting from little 200 l/h units to big plants over 50,000 l/h
Stable emulsion

• The water / diesel emulsions are a modern technology to power diesel engines and boilers for heating, can be formulated with diesel on the market.

• The recent interest in emulsions, as an alternative fuel to diesel fuel, is derived from the potential capacity of water, known already from the beginning of 900, to reduce harmful emissions, such as nitrogen oxides and particulate matter, in the exhaust gas, when is injected into the engine together with fuel (with a separate injection of liquid water or steam, or, better, as a stabilized emulsion).
Water-in-diesel fuel emulsions for use in internal combustion Engines – Requirements and test methods.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Grade A</th>
<th></th>
<th></th>
<th></th>
<th>Grade B</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>kg/m³</td>
<td>Min: 828</td>
<td>Max: 880</td>
<td>Min: 825</td>
<td>Max: 865</td>
<td>EN ISO 12185</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water content a</td>
<td>(m/m)</td>
<td>&gt; 8</td>
<td>15</td>
<td>5</td>
<td>&lt; 8</td>
<td>NF M 07-104</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stability at production (fcr 4200, 5 min), sediment</td>
<td>(V/V)</td>
<td>-</td>
<td>9</td>
<td>-</td>
<td>7</td>
<td>M.U. 1548</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free water</td>
<td>(V/V)</td>
<td>Absent</td>
<td>absent</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity at 40°C</td>
<td>mm²/sec</td>
<td>2,00</td>
<td>5,50</td>
<td>2,00</td>
<td>5,50</td>
<td>EN ISO 3104</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfur content</td>
<td>(m/m)</td>
<td>-</td>
<td>b</td>
<td>-</td>
<td>b</td>
<td>EN ISO 20884</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total contamination</td>
<td>mg/kg</td>
<td>-</td>
<td>b</td>
<td>-</td>
<td>b</td>
<td>EN ISO 20846</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper strip corrosion (3h at 50°C)</td>
<td>index</td>
<td>Class 1</td>
<td>Class 1</td>
<td></td>
<td></td>
<td>EN ISO 2160</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flash point ()</td>
<td>°C</td>
<td>70</td>
<td>70</td>
<td></td>
<td></td>
<td>EN ISO 2592</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total nitrate (2-ethyl-hexyl-nitrate) EHN</td>
<td>(V/V)</td>
<td>0,070</td>
<td>0,050</td>
<td></td>
<td></td>
<td>EN ISO 13759</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lubricity, corrected wear scar diameter (wsd 1,4) at 60 °C</td>
<td>μm</td>
<td>-</td>
<td>400</td>
<td>-</td>
<td>400</td>
<td>EN ISO 12156-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFPP</td>
<td>°C</td>
<td>according to local EN 590</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EN 116d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:

Users are made aware of the fact that initial work at low sulfur levels has indicated matrix-effects for both sulfur test methods.

a. The water portion of the emulsified fuel shall be demineralized to a maximum conductivity of 3 mS/m according to EN 27888.

b. See 4.8 for maximum sulfur (S_max) determination.

c. Use of an appropriate alternative filter is required.

d. The recommended mode is manual, as some automatic instruments need manual sensitivity adjustment for emulsion fuels.
France: Water/Diesel Emulsions

- Water-diesel emulsions which comply with the following specification are eligible for a reduced excise duty rate in France.

<table>
<thead>
<tr>
<th>Fuel Property</th>
<th>Unit</th>
<th>Limit</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density at 15°C</td>
<td>kg/m³</td>
<td>835 - 870</td>
<td>NF M 07-096</td>
</tr>
<tr>
<td>Water content</td>
<td>%(m/m)</td>
<td>9 - 15</td>
<td>NF M 07-104</td>
</tr>
<tr>
<td>Stability, by centrifuge</td>
<td>% (v/v)</td>
<td>- 9</td>
<td>NF M07-101</td>
</tr>
<tr>
<td>Phase separation (after 5 min)</td>
<td>% (v/v)</td>
<td>- 9</td>
<td></td>
</tr>
<tr>
<td>(% sedimentation after 15 min - % sedimentation after 5 min)/10</td>
<td>% (v/v/min)</td>
<td>0.3 -</td>
<td></td>
</tr>
<tr>
<td>Viscosity at 40°C</td>
<td>mm²/s</td>
<td>2.5 - 7.0</td>
<td>NF M07-097</td>
</tr>
<tr>
<td>Sulphur content</td>
<td>mg/kg</td>
<td>*</td>
<td>NF M07-100</td>
</tr>
<tr>
<td>Copper corrosion (3hr at 50°C)</td>
<td>rating</td>
<td>Class 1</td>
<td>NF M07-098</td>
</tr>
<tr>
<td>Flash point (Cleveland)</td>
<td>°C</td>
<td>70 -</td>
<td>NF M07-102</td>
</tr>
<tr>
<td>Lubricity (corrected wear scar diameter, wsd 1.4 at 60°C)</td>
<td>µm</td>
<td>- 460</td>
<td>NF M07-103</td>
</tr>
<tr>
<td>CFPP†</td>
<td>°C</td>
<td>- -15 (winter)</td>
<td>NF M07-099</td>
</tr>
<tr>
<td></td>
<td>°C</td>
<td>0 (summer)</td>
<td></td>
</tr>
</tbody>
</table>

* Sulphur = S(100-y)/100, where S - sulphur in EN590 conforming diesel fuel, y(%m/m) water content of the emulsion.

† Antifreeze additives are allowed for winter grade, provided the total water is unchanged.

- French National Standard – the first Diesel – water standard

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## Italian Specification


<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit of Measurement</th>
<th>Limit</th>
<th>Test Method(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>mily white</td>
<td>visual</td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>kg/m³</td>
<td>835</td>
<td>870</td>
</tr>
<tr>
<td>Water content</td>
<td>%(m/m)</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Centrifuge stability test (4200 rcf after 5 minutes)</td>
<td>%(v/v)</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>Phase separation</td>
<td>-</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>Viscosity at 40°C</td>
<td>mm²/s</td>
<td>2.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Sulphur content</td>
<td>%(m/m)</td>
<td>-</td>
<td>0.031</td>
</tr>
<tr>
<td>Sulphated Ash Content</td>
<td>%(m/m)</td>
<td>-</td>
<td>0.01</td>
</tr>
<tr>
<td>Total Contamination content</td>
<td>mg/kg</td>
<td>-</td>
<td>24</td>
</tr>
<tr>
<td>Copper corrosion (3hr at 50°C)</td>
<td>rating</td>
<td>Class 1</td>
<td></td>
</tr>
<tr>
<td>Flash point</td>
<td>°C</td>
<td>&gt;55</td>
<td>-</td>
</tr>
<tr>
<td>Total nitrate expresses as 2-ethylhexylnitrate (EHN)</td>
<td>mg/kg</td>
<td>750</td>
<td>-</td>
</tr>
<tr>
<td>Lubricity, mean diameter at 60°C corrected to 14 mbar</td>
<td>micron</td>
<td>-</td>
<td>460</td>
</tr>
<tr>
<td>CFPP(6)</td>
<td>°C</td>
<td>-</td>
<td>-10 (winter)</td>
</tr>
<tr>
<td></td>
<td>°C</td>
<td>0</td>
<td>(summer)</td>
</tr>
</tbody>
</table>

Notes:
1. The centrifuge test has to be conducted on the sample taken at the time of delivery.
2. 'Phase separation' refers to the sedimented emulsion.
3. Method ISO 2592 (open cup) is to be used when the flash point is close to the boiling point of water.
4. For arbitration the method EN ISO 3675.
5. The precision data are reported in Appendix A, with the exception of S content, Total ash, and total nitrate.
6. In winter grades it a acceptable to include antifreeze without compromising the water content.
Stable emulsion

- The stabilization is achieved through the use of particular surfactants which prevent for a sufficiently long period (several months) the separation of two insoluble liquid phases.
- The average size of micro droplets of water present in our emulsion is generally less than 1 μ. Measurements have shown that the distribution of the droplets is unimodal centered at about 0.3 to 0.5 μ.
- The innovative technology of our Stable-Box for stable emulsion (our mixer and PLC) and our additives (ACL Series) allow to create stable emulsions, according to regulatory requirements of various states for, both for the diesel and other fuels such as the OC BTZ.
Stable emulsion:
STABLE BOX

• Emulsion Power S.r.l. is able to provide a complete machine, according to the standards of safety, complying to the regulatory requirements of the destination country and to the production requirements of the customer.

• We can provide standard machines, for small consumers, for the production of stable emulsion fuel oil by:
  - 1.500 Litres / Hour;
  - 2.500 Litres / Hour;
  - 5.000 liters / Hour;

• With the technical skills of our specialists and the modularity of our systems, we can build large plants with a flow rate greater than 50.000 liters/hour for use by big client (refineries, distributors off-network,...).
Stable emulsion:  
ITALY : Example of excise reduction

- To take advantage of excise duty, the emulsions are intended for distribution off the network (buses, commercial vehicles and industrial) and for heating.

The excise duty on the emulsion used for **automotive** is **0.28050 €/l**

The excise duty on the emulsion used for **heating** is **0.24516 €/l**

The excise duty on diesel heating is **0.40321 €/l**, so thanks emulsion is obtained a saving of excise **0.15805 €/l**.

The excise duty on diesel automotive is **0.61740 €/l**, so thanks emulsion is obtained a saving of excise **0.3369 €/l**.
Stable emulsion: benefits

- It is used as a common fuel
- Reduction of harmful emissions
- Excise duty reduced on the emulsion produced (FR, ITA)
- Production of the emulsion on site if required
- No changes are necessary to the motor and burners
- Machine controlled directly by EMP in remote control
- Improves the cleaning of the engine and burners
EMULSION POWER KNOW HOW
FIVE strategic components

1. Know How and experience
2. Additive series (ACL additives)
3. Dynamic mixer (Inside the blender unit)
4. Timing of mixing (PLC)
5. Full assistance (Professional team Emulsion Power/ACL)
Additives ACL SERIES

• Emulsion power provides directly to its customers throughout the world the additive necessary to satisfy the needs of the designed and installed system.
• Each machine and each hydrocarbon requires a dedicated additive, according to the specific regulations and requirements of the customer.
• The composition of the additives developed by our research department (Add+Chem Ltd.) produced and marketed in exclusivity by Emulsion Power S.r.l. is unique, protected by trade secrets.

Years of research and direct application have led to the optimization of the formulas of these additives, able to create an emulsion stable in time, performing, restoring the values of cetane and optimizing the lubrication of the injectors or protecting the vanes of generators.
ACD series is an additive dedicated to the preparation of stable emulsions, composed by water and gas oil or water and diesel with biodiesel. This product is used in manufacturing plants “E-box stable emulsions Emulsion Power”, in a dosage of up to 2.5% w/w. Thanks to ACD 317 we can make the stable emulsions reaching 15% w/w of H₂O water content.

To create a stable emulsion is present a molecule, the “emulsifier”, which has affinity to both liquids and is formed by two parts: a head-to-polar group that is attracted by the water and a non-polar tail group drawn from the oil.

The presence of these two parts allows the operation of emulsifier. The molecule of emulsifier remains in contact with both liquids simultaneously. This means that you move to set each interface between the liquids forming a protective barrier.
ACD 317
Typical Characteristics
Emulsions – dispersions of two immiscible liquids

**Stable emulsion**: a dispersion of small (micrometer dimension) of water droplets in diesel stabilised by interfacial surfactants
Surfactants: dipolar molecules able to diminish the surface tension of the two liquids and to stabilise the interface.

- **Polar Head** – affinity for water $\text{H}_2\text{O}$
- **Hydrophobic Tail**. insoluble in $\text{H}_2\text{O}$
The hydrophobic tails of the surfactant fans out into the diesel phase. They create a repulsive barrier preventing other stabilised droplets from getting close to each other.
The nature of these surfactants is also the reason for the secondary detergency function of these additives. These oil soluble molecules are closely related to additives present in engine oils and in fuels for the purpose of cleaning engine parts. The polar heads are attracted to the debris while the tail portion make the dispersion oil soluble.
The stabilised debris is lifted from surfaces and prevented from agglomeration thus keeping clean the engine parts.
The presence of the water droplets in the fuel modifies the injection process by improving the atomisation of the fuel thus enhancing the air-fuel mixing.

The phenomenon of micro explosions refers to the rapid vapourisation and expansion of the water droplets which is the reason for the improvement of the air-fuel mixture.
Additive ACL:
ACL on-demand series

• We developed different additives for our E-BOX:

  – **On-demand** are specific emulsifier additives for the preparation of emulsions in systems E-Box with water and heavy oils, or water and diesel, designed specifically to optimize the combustion of industrial installations of turbines and burners (industrial boilers).

  – **ACH series** emulsifier is an additive for the preparation of emulsions with water and heavy oils (BTZ, ATZ, HFO380, etc.).

  – **ACF series** an additive emulsifier for the preparation of emulsions “On Demand” with water and vegetable oils or animal fats and water.
EMULSION POWER:
ITALY PROJECTS

• Emulsion Power Platform: Arquata project
• Industrial Project: stable box and on-demand system
• Marine project
• Off-network project: heating use
• Off-network project: automotive use (various)
• Harbour terminal project
• Reknown Partners: SDP Distribuzione Petroli
• 2014: 3 new plants foreseen for stable emulsion
Emulsion Power: Italy : Arquata

- Production: 5,000 l/h of stable emulsion with **STABLE BOX 5000**
- **4,000,000 l/year** placed on the market for heating and automotive use
- Additive: **ACD 317**
- Clients: Big resellers (SDP), industrial clients, etc.

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Thank you for your attention

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