

Diesel Emulsions

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Emulsion Systems from 15% up to 50% water content

https://www.dieselnet.com/standards/fr/fuel_emulsion.php water content up to 15%

http://eme-limited.com/tecnologie_dettaglio.php?l=en&a=5 water content up to 20%

https://www.matec-conferences.org/articles/mateconf/abs/2014/04/mateconf_icper2014_02006/mateconf_icper2014_02006.html water content up to 20%

<https://www.hielscher.com/de/power-ultrasound-for-water-in-diesel-emulsions.htm> up to 25%

<https://www.salaenergy.com/fuel-emulsion-water-gasoil-diesel> water content up to 25%

<https://www.ncbi.nlm.nih.gov/pubmed/16806033> Forschungsbericht [Adv Colloid Interface Sci.](#) 2006 Nov 16;123-126:231-9. Epub 2006 Jun 27. Excerpt:

The **combustion efficiency is improved when water is emulsified with diesel**. This is a **consequence of the microexplosions, which facilitate atomization of the fuel**. The review also covers related fuels, such as diesel-in-water-in-diesel emulsions, i.e., double emulsions, water-in-diesel microemulsions, and water-in-vegetable oil emulsions, i.e., biodiesel emulsions

https://sulnoxgroup.com/sn-content/uploads/2018/11/20160523_ricardo-emulsions-reviewed.pdf
DIESEL EMULSION FUELS AND THEIR IMPACTS IN DIESEL ENGINES – A REVIEW AND COMMENTARY
page 6:

It is **possible to create short-lived emulsions and introduce them into combustion almost immediately**. Two such systems are the “Emulsion Engine Feeding System” (EEFS) and the “NoNox Emulsion Combustion System”....the NoNOx website claims **up to 30% water emulsions**.

Diesel mit Wasser Mischen senkt Kraftstoffverbrauch

<https://www.chemie.de/news/38299/diesel-mit-wasser-mischen-senkt-kraftstoffverbrauch.html>

... **Motoren zünden** ohne Probleme **selbst bei 50 Prozent Wasseranteil**. Wenn es gelänge, den Verbrauch um nur wenige Prozent zu reduzieren, könnte weltweit jährlich Rohöl im 100 Millionen Tonnen Maßstab eingespart werden.

... Ebenso stellt es für die Wissenschaftler **kein Problem dar, nachwachsende Rohstoffe wie z.B. Rapsöl** in beliebigen Mengen **einzusetzen**.

Water-Diesel Emulsions : a Review

<https://www.researchgate.net/publication/318574405> Water-Diesel Emulsion

International Journal of Advances in Engineering & Technology, June, 2017.

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WATER-DIESEL EMULSION: A REVIEW

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...The focus of this review paper will be on experiments were previously conducted using a diesel engine with pure diesel fuel and compare it to the emulsion of water-diesel....The purpose was to see the impact of adding the water from 10 % up to 30 % (by volume) to the diesel fuel making the emulsified fuel to investigate the impacts on the emissions and the performance of the engine. ...

http://www.borderlands.de/Links/AquaFuel_flyer.pdf

Good Technologies GmbH Hamburger Landstraße 24 24113 Molfsee (Kiel) Deutschland / Germany

Product: AquaFuel® ist eine eingetragene Marke der Good Technologies GmbH

Unsere Emulgieranlagen zeichnen sich aus durch: ein innovatives Misch- und Zirkulationssystem, das auf chemische Emulgatoren verzichtet und die Wasser-Kraftstoff-Emulsion immer „frisch“ herstellt. eine Anlagensteuerung und ein sensorisches Kraftstoffprüfsystem, das jederzeit eine optimal auf die Betriebssituation abgestimmte Emulsion gewährleistet.

Eine 8-jährige Versuchsreihe in einem stationären Blockheizkraftwerk bestätigt die Zuverlässigkeit und Leistungsfähigkeit unserer Systeme. Seit 2008 bewährt sich eine AquaFuel-Anlage außerdem erfolgreich auf einem Binnenschiff

<https://www.semanticscholar.org/paper/The-Effect-of-High-Water-Content-of-Fuel-on-Diesel-El-Sinawi-Takrouri/6c5f047e3be4c8cc183bab8aaf219527cc4264d8>

The Effect of High Water Content of Fuel on Diesel Engine Emission

.. water contents of 25% and 35% by volume....fuel consumption was found to decrease by increasing water content...

<https://ieeexplore.ieee.org/document/6014903>

Water-in-diesel emulsion and its micro-explosion phenomenon-review

Publisher: IEEE

[Ftwi Y. Hagos](#) ; [A. Rashid A. Aziz](#) ; [Isa M. Tan](#)

... This review paper addresses the influence of micro-emulsion on the combustion and emission of water-in-diesel emulsion fuel. It also presents the effect of operating parameters on the micro-emulsion.

Einfluss der Wasser- oder Emulsionseinspritzung auf die Dieselverbrennung

<https://www.td.mw.tum.de/fileadmin/w00bso/www/Forschung/Dissertationen/steinhilber.pdf>

Einfluss der Wasser- oder Emulsionseinspritzung auf die homogene Dieselverbrennung

Dissertation: Thomas Wolfgang Steinhilber, TU München, Institut für Energietechnik, Lehrstuhl für Thermodynamik

S. 55

.. Sowohl die Idee als auch die tatsächliche Verwendung von Wasser in Verbrennungsmotoren reicht bis in die Zeit der ersten Motoren zurück. Güldner [Gül22] beschreibt einen **Motor** nach Bánki **aus dem Jahr 1894, der mit Wasser-Kraftstoff-Verhältnissen von $\Omega = 2, 33$ (niedrige Leistung) ... bis zu 5,34** (hohe Leistung) bei hohem Kompressionsverhältnis **betrieben werden konnte und damit auf einen beträchtlichen effektiven Wirkungsgrad von bis zu 28% kam.**

Einfluss der Wasser- oder Emulsionseinspritzung auf die homogene Dieselverbrennung"

<https://www.td.mw.tum.de/fileadmin/w00bso/www/Forschung/Dissertationen/steinhilber.pdf>

Dissertation von Thomas Wolfgang Steinhilber an der TU München, 12.12.2007

Kapitel 3.3.1 Einsatz von Wasser bei konventionellen Brennverfahren S. 55 ff

Diesel-Mikroemulsionen als alternativer Kraftstoff (Lada Bemert, Reinhard Strey, Institut für Physikalische Chemie, Universität zu Köln, 50939 Köln, Deutschland Institut für Physikalische Chemie, Universität zu Köln)

http://strey.pc.uni-koeln.de/fileadmin/user_upload/Download/FAD_Konferenz_2007_Manuskript_Lada_Bemert_Reinhard_Strey.pdf

Die Analyse der Emissions- und Verbrauchsdaten aus Motorenversuchen mit Wasser-Diesel Mikroemulsionen zeigt, dass bei gleichzeitiger Erhöhung des Wirkungsgrades der Verbrennungsmotoren und Einsparung an fossilen Energieträgern simultan Ruß- und NOx-Emissionen gesenkt werden.

<http://strey.pc.uni-koeln.de/206.html> Lada Bemert, 2008

...In der vorliegenden Arbeit wurden **Wasser-Diesel-Mikroemulsionen mit bisher nicht erreichter Effizienz und Temperaturinvarianz** entwickelt. ...Kernergebnis ist eine **über 90%-ige Minderung des Rußausstoßes** bei gleichzeitiger NOx-Minderung

Weniger Emissionen dank Diesel-Wasser-Mikroemulsion

<https://www.springerprofessional.de/automobil---motoren/weniger-emissionen-dank-diesel-wasser-mikroemulsion/6584866>

Peter Dittmann vom Lehrstuhl für Verbrennungskraftmaschinen (VKA) der RWTH Aachen 28.3.2014

Patentmeldungen zu Fuel-Water Emulsions

Patentklassen:

B01F2215/0088

Mixing fuel and water or other fluids to obtain liquid fuel emulsions

Weitere Patentklassen :

Classification: - international: *B01F13/10; B01F15/02; B01F3/08; B01F5/00; F02M25/022*; (IPC1-7): *B01F5/00; F02M25/022*
- cooperative: [B01F13/1013 \(EP\)](#); [B01F13/1016 \(EP\)](#); [B01F15/0272 \(EP\)](#); [B01F3/0807 \(EP\)](#); [B01F3/0861 \(EP\)](#); [B01F5/0068 \(EP\)](#); [B01F5/0074 \(EP\)](#); [F02M25/0225 \(EP\)](#); [F02M25/0228 \(EP\)](#); [B01F2215/0088 \(EP\)](#); [Y02T10/121 \(EP\)](#)

http://eme-limited.com/brochure_eme_web.pdf

Patents in the field of emulsion technology ... A **Water in Diesel emulsion** is one of the **most effective ways of both improving diesel fuel combustion and decreasing the output of harmful emissions**. .. EME's patented water in diesel emulsion technology uses a number of proprietary systems to solve different problems.

Patents

<https://books.google.ch/books?id=rcidAAAAMAAJ&pg=PA3&lpg=PA3&dq=patent+applications+water+oil+emulsions+for+motors&source=bl&ots=vJ-7Bfo-W7&sig=ACfU3U0McdZjRQErjUqEF7ybilLeSpmOA&hl=de&sa=X&ved=2ahUKEwi02Y7T5u3kAhVlaFAKHdU5AnMQ6AewB3oECAgQAQ#v=onepage&q=patent%20applications%20water%20oil%20emulsions%20for%20motors&f=false> (1940)

U. S. Court of Customs and Patent Appeals

IN RE KOKATNUR

No. 4,261. Decided February 26, 1940

[109 F.(2d) 647]

PATENTABILITY—EMULSIFIED MOTOR FUEL AND METHOD OF MAKING SAME.

Claims **for** an emulsified motor fuel and claims **for** a method of making same *Held* unpatentable over the prior art.

APPEAL from **Patent Office**. Affirmed.

Mr. Frederic P. Warfield **for** Kokatnur.

Mr. Howard S. Miller **for** the Commissioner of Patents.

In accordance with a preferred embodiment of the invention I could procure or prepare an ammonia soap or amine compound soap and *partially dissolve this soap in the fuel oil*. The amount of soap used will not exceed 3% of the *oil*. The desired amount of *water* is then added slowly and gradually and by agitation of the mixture the emulsion is formed. The principal reason *for adding the water slowly* is to eliminate any reversion of phase, that is to say, prevent the formation of an emulsion with *water* in the continuous phase. The amount of *water* added may vary considerably. I have discovered that the addition of more than 50% of *water* is apt to cause reversal of phase and in practice I have also discovered that 25% by weight of *water* gives highly satisfactory results. [Italics ours.]

...I have discovered that the addition of 25% by weight of water gives highly satisfactory results...
addition of more than 50% water is apt to cause reversal of phase...

<https://worldwide.espacenet.com/publicationDetails/originalDocument?CC=US&NR=4378230A&KC=A&FT=D&ND=3&date=19830329&DB=&locale=en> EP

Patent application US2920948 (A) 1960-01-12 Emulsified Motor Fuel

Method for for **improving fuel economy** and at the same time **reducing pollutants** caused by the use of oil as a fuel, which comprises combusting said oil in the form of an oil-water emulsion, in which said oil-water emulsion is effected by admixing a mixture comprising oil and water with dextrin.

<https://worldwide.espacenet.com/publicationDetails/biblio?DB=EPODOC&II=1&ND=3&adjacent=true&locale=en> EP&FT=D&date=19791018&CC=DE&NR=2814405A1&KC=A1

DE2814405 (A1) — 1979-10-18

Liquid motor fuel – of petrol and water emulsified by ultrasonic vibration
Flüssiger Kraftstoff zum Antrieb von Verbrennungsmotoren

<https://worldwide.espacenet.com/publicationDetails/biblio?DB=EPODOC&II=2&ND=3&adjacent=true&locale=en> EP&FT=D&date=19580429&CC=CA&NR=556683A&KC=A

CA556683 (A) — 1958-04-29 Emulsified Motor Fuel

The proportion of hydrocarbon fuel to water employed vary over the limits of from 8% to 50% by weight of said hydrocarbon to 9% to 50% by weight of water.

<https://worldwide.espacenet.com/publicationDetails/biblio?II=1&ND=3&adjacent=true&locale=en> EP&FT=D&date=20140213&CC=US&NR=2014041288A1&KC=A1

US2014041288 (A1) — 2014-02-13

... They may **reduce emissions**, **reduce fuel consumption** of the load, and otherwise be environmentally friendly

https://worldwide.espacenet.com/publicationDetails/biblio?DB=EPODOC&II=2&ND=3&adjacent=true&locale=en_EP&FT=D&date=20171109&CC=US&NR=2017321138A1&KC=A1

US2017321138 (A1) — 2017-11-09 WATER IN DIESEL OIL FUEL MICRO-EMULSIONS

A water in diesel oil fuel micro-emulsion for internal combustion diesel engines .. with a reduced production of pollutants and carbonaceous side-products generated by the combustion and **very good engine performance**, is described.

DE10334897 (A1) — 2005-03-10 MICROEMULSIONS AND USE THEREOF AS A FUEL

Inventors : STREY REINHARD [DE]; NAWRATH AXEL [DE]; SOTTMANN THOMAS [DE]

The invention relates to bicontinuous microemulsions and to the use thereof as a fuel, combustion or heating fluid. Said fuels permit an increased efficiency of internal combustion systems and heating installations of any type and, simultaneously, a minimised emission of pollutants, associated with combustion, to be obtained.

https://worldwide.espacenet.com/publicationDetails/biblio?II=0&ND=3&adjacent=true&locale=en_EP&FT=D&date=20030227&CC=WO&NR=03016439A1&KC=A1

WO03016439 (A1) — 2003-02-27 WATER-IN-OIL EMULSION FUEL

Inventor: Gunnermann, Rudolf Wilhelm

A water-in-oil emulsion fuel ... method for reducing nitrogen oxide emissions from a compression ignition diesel engine is also disclosed.

https://worldwide.espacenet.com/publicationDetails/originalDocument?CC=DE&NR=102011008331A1&KC=A1&FT=D&ND=3&date=20120712&DB=EPODOC&locale=en_EP

DE102011008331 (A1) — 2012-07-12 Verbrennungsmotor mit Drittmedieneinspeisung

Erfinder: Aumüller-Karter, Claudia / Meyer, Karl