Voulis®

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engine coolants (antifreeze)

TECHNICAL HANDBOOK

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- Problems and solutions
- Technologies
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- BS 6580:2010 standard
- Right use
- Dilution water standards
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flou -15
safety flou -30
coolant
flou -45
hybriflou -30
coolant
flou -20
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flou -45
hybriflou -30
safety flou -30
coolant
flou -15

Engine coolants

Antifreeze

The term antifreeze, in the way it is used and understand is wrong. The proper description is Internal combustion engine liquid coolant with antifreeze (raise the freezing point) anti-thermal (raise the boiling point) and anti-corrosion additives.

Usefulness

High temperatures are created within the combustion chambers and generally on the engine, resulting in a need for a good coolant in order to reduce thermal from metals. The best liquid coolant for this need is water, that although it has a high induction level it creates other problems that seek attention such as freezing in 0° C and boiling in 100° C, and the fact that untreated water is caring hard and corrosive agents.

History of liquid coolants (antifreeze)

Until the 1920 car drivers every afternoon, had to empty the engine from the water to prevent freezing during night. So every morning had to fill it again. Also had to be very careful not to raise the temperature over 100° C because then the water was boiling and the engine quickly destroyed.

Some time and for a short period created a new product based on methanol. In this way the freezing point of water was improved, but created a problem *(because of the high volatility of methanol)*, the evaporation of new product and because of toxicity, corrosion of metals.

Since that time the product started to grow rapidly. Methanol was rapidly replaced by glycols, **MEG** *(monoethylene glycol)* to **PG** *(Propylene glycol)*. Dr Otto Jordan somewhere in the late 1920's mixed glycols with water.

Although glycols are also corrosive *(**MEG** more than **PG**)*, however, improve both the freezing point and boiling point. So the engines even if they had a bit reduced heat dissipation *(in comparison of using only water)*, yet they could work even in extreme operating conditions.

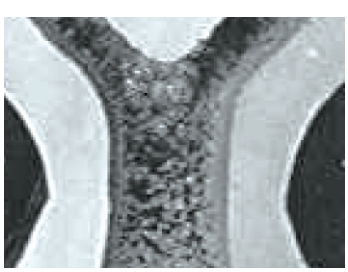
Since the boiling and freezing problem of the water was solved using the above technology, there were more issues to be solved, such as corrosion, cavitation, residues, foaming, the safe contact for the product with rubber materials *(collars etc)* and hard water.

Problems and solutions

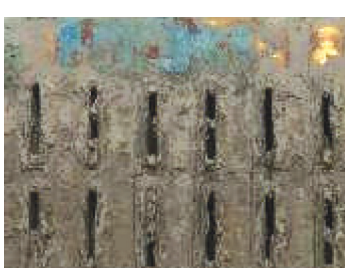
Apart from the reduction of thermal activity, a high technology liquid coolant is necessary, in order to solve the problems below, that are created in an engine working in high temperatures under adverse conditions.

What is corrosion: Corrosion in general means the loss of important properties of a material due to chemical reactions with its environment. The most common use of the term "corrosion" refers to the loss of electrons of metals when reacting with water and oxygen. The forms that corrosion can take is rust, metal ripping, surface corrosion, metal cracks etc.

Corrosion in the cooling system can be faced effectively with the creation of protective layers. These layers are created from the anti-corrosion and anti-rust additives that should be a part of the final product. Moreover, an important deterrent factor is the use in liquid coolant dilutions-antifreeze of only distilled water or reverse osmosis water and not tap water.



What is cavitation: It is the result of the procedure when a vacuum or a bubble within the coolant liquid, falls apart quickly, producing a shock wave that expands on the metal. This phenomenon when repeated, it creates cavitation *(placing concrete bumps)*. This can be destructive. Such damage usually occurs in the water pump impeller. Modern packages of coolant liquids[1]f additives (antifreeze), provide safe treatment of this problem.

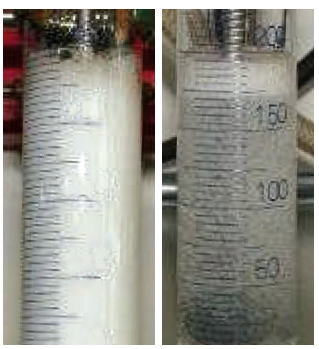


What are residues: Residues are either salt layers that are created on metal surfaces, or slimy form that are met in refrigerator cells.

In both cases, they are unwelcome because they reduce the degree of thermal transparency and impede heat dissipation from the engine, the flow of coolant through the radiator, and accelerate the deterioration of the chemical properties of antifreeze liquid.

The formation of such deposits can be faced, by selecting the mixing of the coolant (antifreeze) in deionized water or reverse osmosis water is best, and with special additives that exist in modern coolant liquids (antifreeze).

What is foaming: As the coolant liquid - antifreeze, passes rapidly through the cooling system and often leads on surfaces and shaken *(eg water pump)*, foaming is creating. This is undesirable because it increases the volume of coolant which in turn increases the internal pressure of the circuit. Under high pressure relief valve of the refrigerator opens, resulting to the loss of coolant (antifreeze). This causes the engine overheat. This phenomenon can be faced with the special antifoaming additives that are used in the modern coolant liquids (antifreeze).



WITH FOAMING | WITHOUT FOAMING

What is compatibility with rubber parts *(collars etc)*: From what has preceded we can perceive that in a coolant liquid (antifreeze) include a wide range of chemicals that react with each other. In coolant liquids (antifreeze) of low quality, it is possible to select "easy solutions" or old technology, which may provide protection against corrosion or deposits but cause damage to rubber parts of cooling circuit e.g. collars. Such damage can be very insidious and dangerous because it gradually removes coolant liquid - antifreeze from the circuit, thus reducing the capacity of heat dissipation and thus the decay beyond rubber parts, the entire engine.

In modern coolant liquids (antifreeze) the study of compatibility of additives used in connection with rubber parts, is a prerequisite pursuant to the requirements of engine manufacturers.

Evolution of the product

Once developed over the decades various additives that overcame these problems, more and newer challenges for this technology came to light in order to meet new needs created by the evolution of materials in the automotive industry, such as new alloys and metals used by automakers eg aluminum, etc. There was the need to develop liquid heat dissipation with high security. Today is still in progress this technological challenge, while more and more automakers choose the most lonely streets offering specialized products instead of **Fighting grade** *(common antifreeze)*.

Three basic technologies developed

For this reason in the flow of time, have developed three main categories and several sub-categories, that specially propose some auto industries.

1. INT (*Inorganic technology*)

Old technology based mainly on silicates and other minerals such as protease Borate - Phosphate - Nitrite - Silicate in order to ensure a high indicator of reserve alkalinity *(alkalinity waiting to neutralize whatever threat of acid)*. This technology, while abducting a sufficient degree of heat from the engine, long-term use may adversely affect rubber parts of the cooling system, and some aluminum alloys used by modern engines. Also has a shorter life *(1 year or 50,000 km)* compared to modern liquid coolant liquids. It is only compatible with older technology engines.

2. OAT category (*organic acid technology*)

Modern technology that uses only organic inhibitors, while some packages ensure high reverse alkalinity using neutralized organic. The technology is considered generally safe for both synchronous aluminum engines and rubber parts. The molecular structure, characterized as **long life** *about 5 years or 250,000 km* if not mixed with other technology. Today is especially prevalent in the technology market.

3. HOAT category (*Hybridic organic acid texnology*)

And this matter is based on the OAT *(organic technology)* ensures a higher **reserve alkalinity** by adding some inorganic inhibitors from category **INT**. Some auto industries wanting to specialize created this rather mixed category and propose for some of their models, the hybrid following subcategories:

1. Subcategory SOAT (*silicate organic acid technology*)

Mostly European manufacturers prefer this technology and propose it in some models of AUDI, VW, SEAT, SKODA.

2. Subcategory PHOAT (*Phosphate organic acid technology*)

It is preferred in some models especially Asian manufacturers such as TOYOTA, KIA, HYUNDAI.

3. Subcategory SBOAT (*Silicate and Borate Organic Acid Technology*)

It is proposed in some models of MERCEDES, SCANIA, VOLVO, PORSCHE.

4. Subcategory SNBOAT (*Silicate-Borate-Nitrite Organic Acid Technology*)

It is preferred mostly by American auto industries CATERPILLAR, CHRYSLER, FORD, JOHN DEER.

Main models catalogue and technologies used

TRADE MARK	COUNTRY	TECHNOLOGY
TRUCKS		
DAEWOO	KR	OAT
DAF	NL	OAT
GMC	US	SNBOAT
IVECO	D	SNBOAT/SBOAT
KENWORTH	US	SNBOAT
LIAZ	CZ	SNBOAT/SBOAT
MACK	US	SNBOAT
MAN	D	SBOAT
MERCEDES-BENZ	D	SBOAT/SNBOAT
MITSUBISHI FUSO	JP	OAT
NISSAN	JP	OAT
PEGASO	E	SNBOAT/SBOAT
RENAULT	F	OAT
TATRA	CZ	SNBOAT
VOLVO	S	SBOAT/OAT
ENGINES		
DAF	NL	OAT
DEUTZ	D	SBOAT/SNBOAT
MAN	D	SBOAT
MTU	D	SBOAT/SNBOAT/OAT
PERKINS	UK	SNBOAT/SBOAT
CONSTRUCTION MACHINERY		
ATLAS	D	SBOAT
DEMAG	D	SNBOAT
GINAF	NL	SNBOAT/SBOAT
GOTTWALD	D	SNBOAT/SBOAT
GROVE	US, D, IT	SNBOAT
HIAB	AT	SNBOAT
LIEBHERR	CH	SBOAT/SNBOAT
FARM MACHINERY		
CNH	NL	SNBOAT
FENDT	D	SBOAT/SNBOAT
JOHN DEERE	US	SNBOAT
JONSERED	AT	SNBOAT

TRADE MARK	MODEL	YEAR OF MANIFACTURE FROM	TO	TECHNOLOGY
Alfa Romeo	all models	1976	2005	SBOAT
	all models	2005		OAT
Audi	all models	1981	1996	SBOAT
	all models	1996	2008	OAT
	all models	2008		SOAT
Bentley	all models	1980	2005	SBOAT
	all models	2005	2008	OAT
	all models	2008		SOAT
BMW	all models	1975		SBOAT
Chevrolet	all models	2001		OAT
Chrysler	all models	1985		SNBOAT
Citroën	all models	1993		OAT
Dacia	all models	2005		OAT
Daihatsu	all models	1979		OAT
Dodge	all models	1985		SNBOAT
Ferrari	all models	1979	2005	SBOAT
	all models	2005		OAT
Fiat	all models	1982	2005	SBOAT
	all models	2005		OAT
Ford	all models		1997	SBOAT
	all models	1998		OAT
Honda	all models	1983		OAT
Hyundai	all models	1982		OAT
Jaguar	all models	1986	1997	SBOAT
	all models	1997		OAT
Jeep	all models			SNBOAT
KIA	all models	1991		OAT
Lada	all models			SBOAT
Lancia	all models	1976	2005	SBOAT
		2005		OAT
Land Rover	Freelander, Discovery, Defender,			
	Range Rover	1998		OAT
	Range Rover V8 and Diesel 1998	2005		SBOAT
Lexus	all models	1994		OAT
Lotus	all models	1980	1999	SBOAT
	all models	2000		OAT

TRADE MARK	MODEL	YEAR OF MANIFACTURE FROM	TO	TECHNOLOGY
Mazda	all models	1977		OAT
Mahindra	all models			SBOAT
Mercedes	all models	1976		SBOAT
	all models			OAT
MG Rover	all models	1982		OAT
MINI	with petrol engine	2001		SBOAT
	Diesel	2007		OAT
Mitsubishi	all models	1982		OAT
	Carisma	1996	2004	SBOAT
	Colt	2004	2007	SBOAT
Morgan	all models			SBOAT
Nissan	all models	1982		OAT
Opel	all models	1975	2000	SBOAT
	all models	2001		OAT
Peugeot	all models	1993		OAT
Porsche	all models (except 911)		1995	SBOAT
	all models	1996		OAT
	911, Boxster, Cayman, Cayenne, Panamera	1997		SOAT
Renault	all models	1985		OAT
Rolls-Royce	all models			SBOAT
Saab	all models	1975	2000	SBOAT
	all models	2001		OAT
Seat	all models	1985	1996	SBOAT
	all models	1997	2007	OAT
	all models	2008		SOAT
Skoda	all models	1989	1998	SBOAT
	all models	1998	2008	OAT
	all models	2008		SOAT
Smart	all models	1998		SBOAT
Subaru	all models	1977		OAT
Suzuki	all models	1981		OAT
Toyota	all models	1978		OAT
Volkswagen	all models	1975	1996	SBOAT
	all models	1997	2008	OAT
	all models	2008		SOAT
Volvo	all models	1982		SBOAT

BS 6580:2010 standards

Taking into consideration those evolutions on the technology of cooling the engine, it was created an reliable enough house *(BSI standards publication)* the **British Standards BS 6580: 2010**

The above Standard defines all aspects of construction an MFN coolant - antifreeze and specifies for each parameter and the following methods of confirmation:

Characteristic	Control method
Boiling point	**ASTM D 1120**
Freezing point	**ASTM D 1177**
Control oxidation	**ASTM D 1384**
Control of foaming tendency	**ASTM D 1881**
Control of Glycol specification	**ASTM D 3306**
Control of wear of aluminum alloys	**ASTM D 4340**
Control Denatonium Ionin	**ASTM D 7304**
Control of hardness of water	**ASTM D 7437**
Control of water and derivatives	**BS EN ISO 2592/BS 2000-36**
Control of water for laboratory use and requirements	**BS EN ISO 3696:1995**

VOULIS CHEMICALS

Coolant liquids (antifreeze – solutions flou)

Voulis chemicals in cooperation with major European houses, closely following the technological developments, developing always in accordance with **BS 6580:2010** all the above technologies and several subcategories according to specifications. Below is a list of products and technologies that follow.

Product name	freezing point	colour	technology	notes
coolant concantrate (antifreeze)	concentration	green	OAT	**Contemporary technology** compatible with all **OAT** long lasting (5 years or 250.000 km)
flou -15/-20/-30	-15/-20/-30° C	green	OAT	**Contemporary technology** compatible with all **OAT** long lasting (5 years or 250.000 km)
flou -45	-45° C	red	OAT	**Contemporary technology** compatible with all **OAT** long lasting (5 years or 250.000 km)
safety flou -30	-30° C	magenta	OAT	**New generation** (9 ml) reserve alkalinity without silicate WIDE COMPATIBILITY
hybriflou -30	-30° C	green blue yellow	HOAT	**Hybrid technology** contains silicate **SBHOAT**

Coolants without antifreeze protection in engines (*ships etc*)

Ships in particular, but also in other internal combustion engines the closed circuit where the heat dissipation takes place with water without antifreeze protection *(ie, glycol)*, water still has the same corrosive problems mentioned above.

Voulis chemicals developed a technology of mixing additives into the water, that protect against corrosion - rust- cavitation and residues and foaming.

What we should pay attention to during the use of coolant liquids (antifreeze)

1. 1. If a car uses eg INT technology and coolant-antifreeze is OAT technology, or HOAT ... are they compatible with each other?

The answer is primarily **no**. The best thing would be to replace the whole liquid and use the same technology. However, tests showed that up to certain amount of mixing around 10% the situation is rarely altered. The biggest problems *(increase alkalinity - possible deposits of reaction - sure loss of the advantage of long lasting-corrosion problems in aluminum engines and other specialized metal and the rubber parts)* is mainly caused when mix **INT** *(old technology)*, within **OAT** or **HOAT** *(modern technologies)*. **But generally it is recommended to use coolant liquids, antifreeze solutions of the same technology.**

2. Never use solid concentrate coolant liquid (antifreeze), because without water there is no heat transfer *(the more water it contains the final solution, the higher transfer rate it has)*. So, always with the addition of water, **but beware**, when mixed with water is very important not to use tap water, but well-distilled or reverse osmosis water. The water contains calcium, magnesium and other hard metals and chlorinators. These are components that inactivate whom inhibitors containing additives and cancel the corrosion activity, making it a corrosive coolant.

3. If you prefer liquid coolant ready for use, solutions *(flou)*, they should be constructed to the required specifications of safety water BS 6580:2010 *(ASTM D 7437 - BS EN ISO 2592/BS 2000-36 - BS EN ISO 3696:1995)* . *They do not require any mixing with water.*

4. A reasoning like **«if I fill it up all the time, there is no need to replace it»** is wrong. When the new liquid comes in contact with the old, it is infected

with all the oxidation that has absorbed the old one. Laboratory studies have shown that mixing old with new fluid should exceed 10%. It should be full restoration with new.

5. During the replacement of the coolant the safest way is the one below:

• Unscrew the bottom cap, or pull the down collar of the fridge and remove the old fluid.

• Screw the cap or replace the collar and fill well only distilled or reverse osmosis water. If you wish you can add the special refrigerator cleaner from VOULIS product line, name **rad**.

• Start the engine and let it work a long enough to open the thermostat in order to clear the circuit from the residue of the old coolant liquid and any other deposits. In that way you will not contaminate the new liquid.

• After 20-30 minutes app. with the same way remove the cleaning liquid and close up again the circuit.

• Insert slowly, to properly fill and bleed the good new coolant. Start the engine, and after the thermostat opens, you stop the engine and fill coolant again, until you are sure that no air is trapped in the circuit.

6. If by mistake oil enters into the cooling system, how can I clean it properly?

After repairing the damage

• Unsrew the bottom cap, or pull down clamp and remove the old fluid.

• Screw the cap to replace the collar and fill well only distilled or reverse osmosis water, adding the product **cirquit** from **VOULIS** product line.

• Start the engine and let it work enough, after opening the thermostat achieve a completely emulsified water with the produc, and residue oil.

• After 20-30 minutes,in the same way, eliminate the emulsion created and close the circuit.

• Refill with reverse osmosis water and add the product **rad** (radiator cleaner) from **VOULIS** product line.

• After 20-30 minutes, in the same way remove the cleaning fluid and close the circuit.

• Insert the good new coolant slowly, in order to achieve proper fill up and bleed. Start the engine, and after the thermostat opens, switch off and fill up with coolant again, until you are sure that no air is encapsulated in the circuit.

Colouring

Coloring means anything as to recognize compatibilities?

The answer is no. Coolant liquids of old **INT** technology where mostly green, intense green in order to color water and everyone could see that the refrigerator contained coolant liquid.

Today, there is no coloring regulations, only common uses. **OAT** are usually green or red and some magenda 91. **SOAT** are blue or green. **PHOAT** are mostly magenda 91. **SNBOAT** are in majority yellow. However it is not absolute. Coolant liquids are colorless and the manufacturer can color it according to his wish or the commercial practice of his area.

Remember always, that compatibilities are a matter of technologies and requirements and **not color.**

Are coolants with MEG compatible for use in solar system heaters and other cooling circuits?

Of course. Despite the fact that the earlier technologies recommended as a coolant inhibitor of PG *(propylene glycol)* modern technology with **OAT** that contains corrosion inhibitors, makes refrigeration products with **MEG** *(1-ethylene glycol)* secure and functional.

Water

From all the above it is concluded that an important role in heat dissipation and corrosion of metals and elastomers, play water use. **VOULIS CHEMICALS** developed the technology of **2-reverse osmosis** - treated laboratory succeeded, where water covers all high water standards **ASTM D 7437 - BS EN ISO 3696:1995** and **ASTM D 3306**.

What we should take into considerations according to legislation.

1. Packaging both for the concentrated coolant liquid (antifreeze), and for the solutions (flou) should refer clearly that is according to specifications **BS 6580:2010**.

2. Packaging sould refer clearly the legislation that is followed by the product. E.g. organic acid technology etc, so that the user can easily check the compatibility.

3. BS 6580:2010 forbids the existence for an antifreeze solution with freezing point less than **-15° C.**

4. The content should be clearly mentioned on the package in liters and not kilograms.

5. Violation of the above burden by law not only the producer and everyone involved traders before the final consumer.

representative - αντιπρόσωπος

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