Hydro's environmental profile

Responding to environmental challenges is a precondition for the management of modern industrial activity. This forms the basis for our key strategic principles:

We will demonstrate a strong sense of responsibility for people and the environment. Hydro will be at the forefront of environmental care and industrial safety.

Hydro's mission is formulated, therefore, according to the following:

We will make care for the environment and for the wellbeing of future generations the basis of our company policy and decision making.

The products that we manufacture shall meet the following demands if they are to be marketed:

We will design our products to have the minimum adverse effect on the environment throughout their entire life cycle.

We will promote the correct and appropriate use of our products to minimize pollution and risks.

We will encourage re-use and recycling of our products.

This is where HYCOOL enters as a product. A product that complies with the above mentioned goals and requirements. HYCOOL is a secondary refrigerant with an excellent environmental profile. It can be used in freezing, cooling and heating applications. The continuous research and development around HYCOOL is aimed at increasing knowledge about the systems in which HYCOOL is used. The solutions that we choose must be suitable for the environment from a long-term perspective and contribute towards making our environmental investments more effective.

Our wish is to show openness in the environmental issues surrounding HYCOOL. We will prepare and publish information about all the essential environmental conditions that can be or are connected to HYCOOL. To demonstrate this, Hydro Chemicals has produced this environmental brochure for HYCOOL.

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Refrigeration industry

Three major international meetings are encouraging the refrigeration industry to develop more environmentally sound working methods. The Montreal protocol concerning the effects on the ozone layer, the UN's conference in Rio de Janeiro concerning the environment and development and the Kyoto protocol concerning the greenhouse effect. These three meetings have shown that it is possible to maintain a good quality of life without endangering the lifestyle of future generations.

Hydro Chemicals are in agreement with the aims of the directives. HYCOOL provides the industry with a product that meets the requirements of the industry.

HYCOOL has outstanding thermodynamic properties, minimising both capital and operational costs.

HYCOOL has low viscosity and high thermal conductivity. Combined, they result in reduced installation and energy costs.

HYCOOL has excellent environmental properties. It is non-toxic, non-flammable, biodegradable and gives low general corrosion on the metals commonly used in the systems.

HYDRO

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Biodegradability and toxicity

HYCOOL consists of 30-50% potassium formate, 50-70% water and 0-1% corrosion inhibitor. Tests made on potassium formate show that the substance has an excellent environmental profile, see below. The tests are relevant for HYCOOL as it consists primarily of potassium formate and water. They show that any spillage or leakage of HYCOOL onto the ground or into sewage systems has no major impact.

ThOD and BOD

According to tests that have been carried out at the Huntingdon Research Centre in the UK, HYCOOL can be regarded as biodegradable. This is shown by the following formula:

$BOD_{15}(gO_2/g) / ThOD_{15}(gO_2/g) \cdot 100 =$

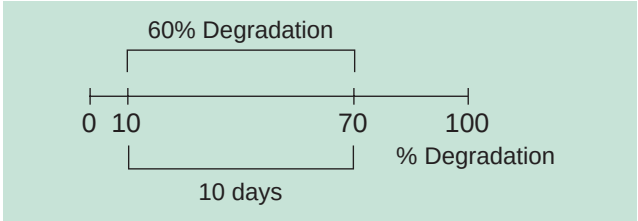
% degraded after 15 days

0.085 / 0.095 = 89%

HYCOOL has a slow initial degradation, increasing after 5 days until it reaches a degradation level of over 90% – to CO_2 and H_2O – within 28 days.

Time Window Criterion

HYCOOL can be regarded as easily biodegradable according to OECD. In order for a product to be classified as biodegradable according to OECD's guidelines, it must pass the "Time Window" test. HYCOOL meets the requirements of this test for optimal biodegradation, i.e. HYCOOL degrades by a further 60% within 10 days after 10% of HYCOOL has been degraded.



The tests show that HYCOOL is readily biodegraded in an aqueous environment under aerobic conditions.

HYCOOL has a much lower consumption of oxygen when it is is biodegraded in comparison to other commonly used secondary refrigerants such as potassium acetate, ethylene glycol and propylene glycol.

Biodegradation in soil

Tests on the degradation in soil carried out by Jordforsk in Norway, state that HYCOOL has good biodegradability in soil even in high concentrations.

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Toxicity

HYCOOL can be regarded as not toxic for animals, aquatic organisms and humans. This is illustrated in the following tables:

Fish		
$LC_{50/24h}$(mg/l)	4600	Rainbow trout
$LC_{50/96h}$(mg/l)	3500	Rainbow trout
$LC_{50/48h}$(mg/l)	3200	Golden orfe
$LC_{50/96h}$(mg/l)	1700	Scopthalmus maximus

Water flea		
$EC_{50/24h}$(mg/l)	1000	Daphnia magna
$EC_{50/48h}$(mg/l)	540	Daphnia magna

Algae		
$IC_{50/72h}$(mg/l)	>1000	Scenedesmus subspicatus
	1000	Skeletonema costatum

Other		
$LC_{50/24h}$(mg/l)	531	Acartia tonsa
$LC_{50/96h}$(mg/l)	1300	Crangon crangon
$IC_{50/16h}$ (mg/l)	71600	Pseudomonas putida

Acute oral toxicity

Potassium formate $LD_{50/p.o.}$(mg/kg) >2000 (for mouse approx. 5500)

Handling and safety

HYCOOL is safe to handle. It is non-flammable, has no flash point, is chemically stable and non-toxic.

HYCOOL mainly consists of potassium formate and water. Potassium formate, as a substance, is not referred to in the EC's substance directive.

Product classification, WGK

This product classification affects conditions for transport, storage and waste. It is based on keywords such as oxygen reduction, eutrophication and discharge of nitrates and has been included in the European regulations that protect our water environment.

HYCOOL has been assessed as not having any harmful effects on a water environment, or WGK 0.

Dermal Response Test

This test, carried out by Covance Laboratories Ltd in the UK, is based on skin irritation in relation to time of exposure, and shows that HYCOOL does not cause skin irritation. People with sensitive skin may experience a certain irritation upon direct contact, however the substance cannot be regarded as dangerous. Hydro Chemicals advises the use of protective gloves and goggles in the handling of all chemicals.

Product classification

HYCOOL is not listed as a hazardous product/substance as it does not exhibit any of the characteristics that would cause it to be classified as a hazardous substance according to approved tests. This assessment is based on the EU's expert committees, the EU's economic committees and the national laws that apply.

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Climatic impact

As previously mentioned, the focus is on reducing the environmental impact of today's refrigeration systems. Hydro Chemicals uses this as a starting point. From only working with ammonia in both direct and indirect refrigeration systems, we now use HYCOOL – for the secondary side – in existing indirect systems and new systems that are being designed. HYCOOL enables us to drastically reduce the environmental impact of a refrigeration system. Environmental impact is often measured in ODP or GWP, but a more relevant factor has recently been introduced, TEWI.

ODP

Ozone Depletion Potential. This is an estimated value of the ecological impact of a chemical in the atmosphere, in relation to the depletion of the ozone layer.

GWP

Global Warming Potential. This is an estimated value of the ecological impact of a chemical in the atmosphere, in relation to increasing the greenhouse effect.

TEWI

Total Equivalent Warming Impact. This factor has been introduced for estimating the total global warming impact that a refrigeration system could cause. TEWI measures both the direct global warming impact from the refrigeration system (based on leakages during its lifetime and recovery losses) and the indirect impact on the energy consumption during the lifetime of the system.

$$TEWI = (GWP \cdot L \cdot n) + (GWP \cdot m \cdot [1-R]) + (n \cdot E \cdot B)$$

where:

GWP	=	Global Warming Potential of the primary refrigerant
L	=	Primary refrigerant leakage each year [kg]
n	=	The operating life of the system [years]
m	=	Amount of primary refrigerant [kg]
R	=	Recovery ratio of the primary refrigerant
E	=	Energy consumption per year [kWh]
B	=	CO_2 emission per kWh

If the relevant data for a specific refrigeration system is applied to the formula above, the result will show that the use of HYCOOL leads to a reduction in the impact of the system's greenhouse effect.

Summary

HYCOOL is not toxic to humans, animals and aquatic organisms and is readily biodegradable in water and soil systems.

HYCOOL has a lower BOD value than other commonly used secondary refrigerants. This means that if spillages or leakages should occur, the oxygen consumption in soil, surface water and effluent treatment processes would be strongly reduced in comparison to other secondary refrigerants.

HYCOOL is not listed as a hazardous product/substance as it does not exhibit any of the characteristics that would cause it to be classified as a hazardous substance according to approved tests.

HYCOOL does not cause skin damage during normal usage (people with sensitive skin may experience slight skin irritation).

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Notes