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Odpornost kovinskih materialov proti tekočim biogorivom in alternativnim gorivom in njihovim zmesem

Resistance of metallic materials to liquid biogenic and alternative fuels and their blends

Beständigkeit metallischer Werkstoffe gegenüber flüssigen biogenen und alternativen Brennstoffen und deren Blends

Résistance des matériaux métalliques aux biocombustibles liquides, aux combustibles liquides alternatifs et à leurs mélanges

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Resistance of metallic materials to liquid biogenic and alternative fuels and their blends

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Beständigkeit metallischer Werkstoffe gegenüber flüssigen biogenen und alternativen Brennstoffen und deren Blends

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Contents

Page

European foreword **3**

Introduction **3**

1 Scope **5**

2 Normative references **5**

3 Terms and definitions **5**

4 Materials **6**

5 Liquid fuels **8**

6 Resistance of metallic materials to liquid biogenic and alternative fuels and their blends **8**

7 Test procedure on resistance **12**

8 Recommendations on material selection for components in supply systems **13**

9 Conclusion **13**

Annex A (informative) **National requirements for liquid fuels** **14**

A.1 General **14**

A.2 Category A: Liquid fuels derived from petroleum refining processes **14**

A.3 Category B: Liquid fuels from renewable resources **14**

A.4 Category C: Combinations of category A and B **15**

Bibliography **16**

European foreword

This document (CEN/TR 17144:2017) has been prepared by Technical Committee CEN/TC 47 “Atomizing oil burners and their components - Function - Safety - Testing”, the secretariat of which is held by DIN.

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Introduction

Both the limited range and scope of crude oil and other fossil energy sources, as well as the impact on the climate resulting from the anthropogenic output of greenhouse gases, have led to a politically induced initiation of the restructuring of energy usage.

In addition to increasing actual efficiency in the technical utilization of fossil energy sources, the focus is on the development and expansion of renewable energies. The integration of regenerative resources in sustainable heat generation can reduce the output of greenhouse gases such as CO_2, as well as the need for fossil energy sources. As a bio-component of blends, fatty acid methyl ester (FAME) is currently used. As a result of the chemical/physical properties, as well as evaporation and combustion characteristics, experience shows that an admixture is possible up to 30 % (V/V) FAME [22, 23]. Due to the possible interactions of the blends with components and in particular with non-ferrous metals such as copper/brass, the manufacturers of consuming units and devices have approved their products only to a limited extent for such an admixture. By contrast, the manufacturers of tanks and components in the fuel piping consider their products to also be suitable for blends with higher admixtures.

However, with regard to the increasing market penetration of blends as a liquid fuel with biogenic or alternative admixtures, requirements for the materials used should be defined and stipulated as standard. There is, therefore, the need to prove the resistance of the materials used against these fuels.

1 Scope

This Technical Report includes application-relevant metallic materials of supply systems for liquid fuels and their blends with regard to corrosive or service life reducing influences. Assessment of the specialist literature showed possible interactions with biogenic and alternative fuels and motor fuels as well as their blends with mineral oil and motor fuels. The results of this assessment are given in this CEN/TR.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1
material
raw, semi-finished or finished substance of given characteristics from which processing into a component or part is undertaken

[SOURCE: EN 16603-10-03:2014, 3.1.12, modified: deletion of "(gaseous, liquid, solid)"]

3.2
corrosion
physicochemical interaction between a metal and its environment that results in changes in the properties of the metal, and which may lead to significant impairment of the function of the metal, the environment, or the technical system, of which these form a part

[SOURCE: EN ISO 8044:2015, 2.1, modified: deletion of the note]

3.3
liquid fuel
fuel which consists of mineral fuel based fractions and which remains in its liquid state under standard temperature and pressure conditions

[SOURCE: EN 13878:2003, 3.22, modified: added mineral fuel based fractions]

3.4
liquid biogenic fuel
liquid fuel which consists 100 % (V/V) of biogenic contents

3.5
liquid alternative fuel
liquid fuel which consists 100 % (V/V) of contents that is not contained in conventional mineral fuel based liquid fuels

3.6
blend
liquid fuel consisting of mineral fuel based fractions and admixtures of liquid biogenic and/or liquid alternative fuels

3.7
motor fuel
aliphatic hydrocarbon component of mineral oil

Note 1 to entry: The term “fuel” is only used in this CEN/TR for the purpose of evaluating the existing specialist literature.

Note 2 to entry: The term “motor fuel” is valid for the use in vehicles.

3.8
biodiesel
liquid motor fuel which consists 100 % (V/V) of liquid biogenic fuels

Note 1 to entry: see Clause 5 category B.

4 Materials

Table 1 lists material groups and materials, which are used in supply systems for liquid fuels. In the case of the material groups in Table 1 an evaluation of the literature has shown that the resistance against biogenic and alternative fuels and their blends may be limited.

The material groups steel, stainless steel and cast iron were not considered here as no limitation of resistance is known for these materials.

Table 1 — Material groups with materials in supply systems for liquid fuels, liquid biogenic fuels and blends

Material group	Material	Material number	Use, Notes
Aluminium	EN AW-Al99,5	EN AW-1050A	
Aluminium	EN AW-Al99,0	EN AW-1200	
Aluminium	EN AW-AlCuPbMgMn	EN AW-2007	Aluminium machine alloy
Aluminium	EN AW-AlCu6BiPb	EN AW-2011	Aluminium alloy
Aluminium	EN AW-AlCu4PbMg	EN AW-2030	Aluminium machine alloy
Aluminium	EN AW-AlMn1	EN AW-3103	Aluminium pipe
Aluminium	G-AlSi7Mg	EN AW-4018	Cast aluminium
Aluminium	EN AW-AlMg5	EN AW-5019	Aluminium wrought alloy
Aluminium	EN AW-AlMgSiPb	EN AW-6012	Aluminium machine alloy
Aluminium	EN AW-Al Si1Sn1MgBi	EN AW-6023	
Aluminium	EN AW-AlMgSi	EN AW-6060	
Aluminium	EN AW-AlSi1MgMn	EN AW-6082-T6	Aluminium machine alloy
Cast aluminium	EN AB-AlSi7Mg0,3	EN AB-42100	Cast aluminium
Cast aluminium	EN AC-AlSi7Mg0,3	EN AC-42100	Cast aluminium
Cast aluminium	EN AC-AlSi12Cu1(Fe)	EN AC-47100	
Cast aluminium	EN AC-AlSi12(a)	EN AC-44200	Cast aluminium
Cast aluminium	EN AC-Al Si12(Fe)	EN AC-44300	
Copper	Cu-ETP	CR004A	

Material group	Material	Material number	Use, Notes
Copper	Cu-FRHC	CR005A	
Copper	Cu-ETP	CW004A	
Copper	Cu-DHP	CW024A	Pipe
Brass	CuSn10-C	CC480K	Bronze
Brass	CuZn33	CW506L	
Brass	CuZn36	CW507L	
Brass	CuZn37	CW508L	
Brass	CuZn38Pb2	CW608N	
Brass	CuZn39Pb2	CW612N	Machining brass
Brass	CuZn39Pb3	CW614N	Machining brass
Brass	CuZn39Pb3	CW614N	Hot-pressed brass
Brass	CuZn39Pb3 - H080	CW614N - H080	Hot-pressed brass
Brass	CuZn39Pb3 - min.R360 - S	CW614N - min.R360 - S	Machining brass
Brass	CuZn39Pb3 - MS	CW614N - MS	Machining brass
Brass	CuZn40Pb2	CW617N	Hot-pressed brass
Brass	CuZn40Pb2 - H080	CW617N - H080	Hot-pressed brass
Brass	CuZn40Pb2 - min.R360 - S	CW617N - min.R360 - S	Machining brass
Brass	CuZn40Pb2 - MS	CW617N - MS	Machining brass
Brass	CuZn20Al2As	CW702R	
Brass	CuZn35Ni3Mn2AlPb	CW710R	Special machining brass
Brass	CuZn35Ni3Mn2AlPb - H080	CW710R - H080	Special hot-pressed brass
Brass	CuZn35Ni3Mn2AlPb - R490/H120	CW710R - R490/H120	Special machining brass
Brass	CuZn37Mn3Al2PbSi	CW713R	Special hot-pressed brass
Brass	CuZn40Mn2Fe1	CW723R	
Brass	CuZn21Si3P	CW724R	”Cuphin”, ”Ecobrass”, ”Ecocast”
Brass	CuZn35Pb2Al	CC752S	Cast brass, de-zincification resistant
Brass	CuZn39Pb1Al	CC754S	Cast brass
Brass	CuZn39Pb1AlB	CC755S	Cast brass (“MS-Fine Grain”)
Zinc high pressure die casting	GD-ZnAl4Cu1	ZP0410	

5 Liquid fuels

Three categories are specified for liquid fuels:

Category A Liquid fuels derived from petroleum refining processes with a maximum viscosity of 10 mm^2/s at 20 °C, e.g. fuel category ISO-F-D according to ISO 8216-99.

NOTE 1 Liquid fuels derived from petroleum refining processes are listed in CEN/TR 15738.

Category B Liquid fuels from renewable resources, e.g. FAME according to EN 14214 or alternative fuels.

Category C Mixtures of category A and B, e.g. diesel as a motor fuel according to EN 590, EN 15940, EN 16709.

NOTE 2 For national requirements for liquid fuels, see Annex A.

6 Resistance of metallic materials to liquid biogenic and alternative fuels and their blends

Statements from the literature on the resistance of the material groups against biogenic and alternative fuels and their blends are collated in Table 2.

The test methods or test conditions of the published specialist literature references are only rarely described with precision. Therefore, an own evaluation of the resistance of the various different material groups against biogenic and alternative fuels and their blends was effected in Table 2.

Table 2 — Specialist literature references on the resistance of materials against biogenic and alternative fuels and their blends

Test method/Test conditions	Category according to Clause 5	Fuel	Material group with evaluation on resistance				Notes	Source
			Aluminium	Copper	Brass	Zinc high pressure die casting		
n. n.	B	FAME	0	4	0	0	-	[1]
n. n.	B	FAME	0	3	0	0	-	[2]
Static immersion test at 100 °C	B	FAME	0	3	0	0	-	[3]
n. n.	B, C	Biodiesel	0	0	3	0	-	[4]
n. n.	A	Crude oil	1	0	0	0	Corrosion rate: (0,05 to 0,5) mm/a	[5]
n. n.	B	FAME	2	0	0	3	-	[6]
n. n.	B, C	Biodiesel	0	3	3	0	-	[7]
n. n.	C	FAME	1	4	4	4	-	[8]
n. n.	B	Biodiesel	1	0	0	0	-	[9]
n. n.	B, C	Biodiesel	2	3	0	0	-	[10]
Static immersion test; room temperature for 2,640 h; 60 °C for 840 h	A, B, C	Biodiesel	0	2	0	0	Corrosion rate: 0,001 mm/a; corrosion at increased temperature	[11]
Immersion test, stirred; 80 °C for 1,200 h	B, C	Palm oil biodiesel	2	3	0	0	Corrosion rates: Cu 0,015 mm/a Al 0,005 mm/a	[12]
Immersion tests according to ASTM G1 at room temperature and ASTM G31 at 55 °C	B	Biodiesel	0	4	4	0	Lower corrosion rates with O_2 exclusion	[13]