



Researcher Links UK-Russia Workshop

**Scientific and Technical Grounds of Future
Low-Carbon Propulsion**

19th - 22nd November 2018, Northumbria University at Newcastle, UK

Special aspects of production and practical use of 2-methyl- and 2,5-dimethylfuran as promising high-octane additives to gasoline

Mikhail Kotelev

Gubkin University

Russia, Moscow



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Gubkin University

Founded in 1930

26 research laboratories

15 research and educational centers



65 Leninsky Prospekt, Moscow, 119991, Russia

Received the status of 'National Research University' in 2010.

Over 11,000 students

international students from more than 50 countries

The main research areas include:

- search and exploration of oil and gas;
- oil and gas fields development;
- oil products and gas supply;
- mechanical engineering;
- chemical engineering and environmental science;
- automation and computer engineering

University campus contain five buildings for 4,176 accommodation places, including the stadium, several gyms, leisure centers, business school, theater hall and music club.



Physical and Colloid Chemistry Department



*Number of Q1 Articles
18 (2017)
(51 % of the entire university)*



The main research areas:

- catalysis;
- alternative fuels;
- composites;
- natural nanomaterials
- biorefinery



*Research funding
– 2,5 million euros
(20% of the entire university)*





Comparison with other oxygenates

	MF / DMF	MTBE	Ethanol	NMA
Structure				
b-RON	184 / 185	135	134	280
Working concentration	up to 5 %	5–15 %	5–15 %	1–2 %
Boiling point	64 / 92 °C	55 °C	78 °C	196 °C
NFPA class	MF: 4 (Certified as food flavoring) DMF: 3	2	2	3
Legal status	legitimate	prohibited in many countries, legitimate in Russia	legitimate	prohibited in Russia



Situation in Russia

Deficit of high-octane components

low refinery modernization rates

high rates of environmental law enforcement

High demand for oxygenates (MTBE, ETBE, isobutanol)

MTBE production in Russia - more than 1.5 million tons per year

NMA and other arylamines have been banned since 2016

**In accordance with the Technological regulations
of the Customs Union**

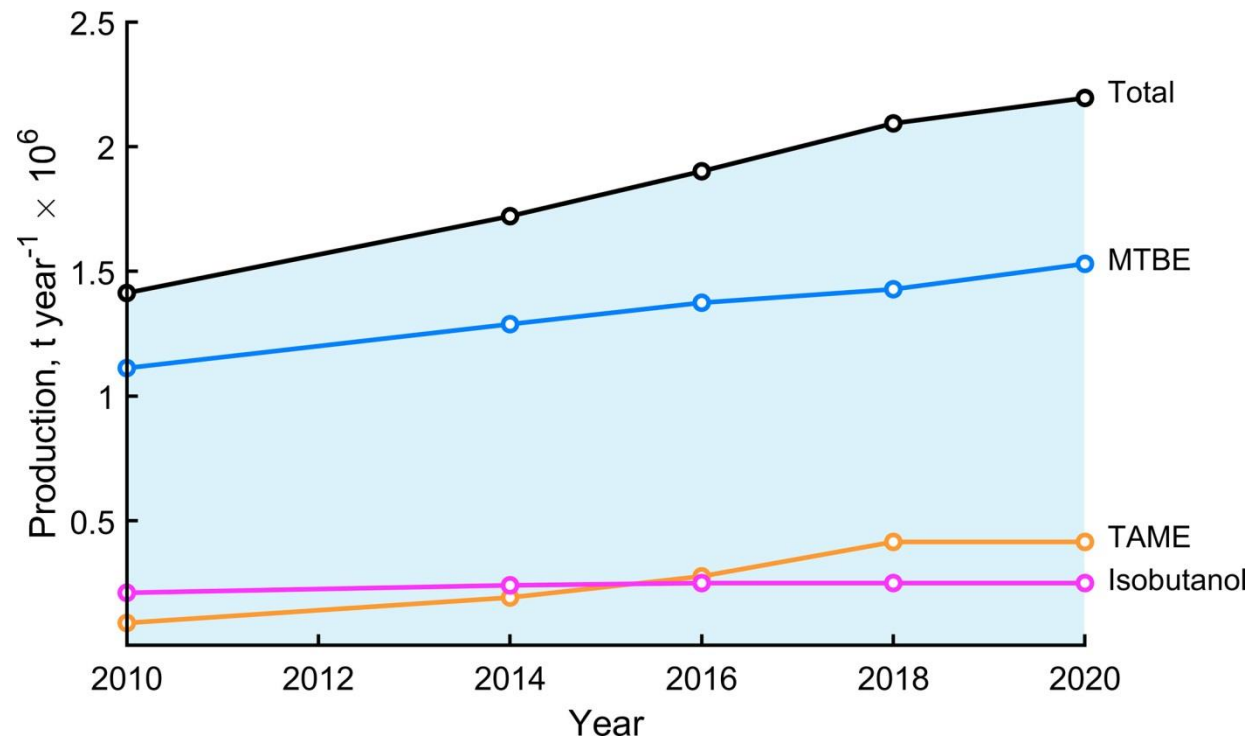
Significant amount of sugar-containing and lignocellulosic raw materials

molasses, agricultural and wood industry waste

Ethanol will never be used as a fuel



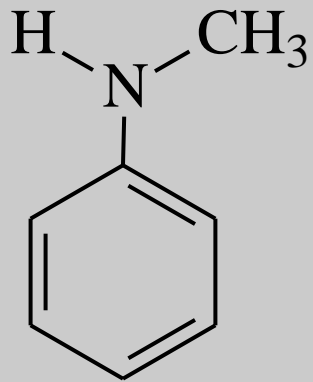
Production and consumption of oxygenates





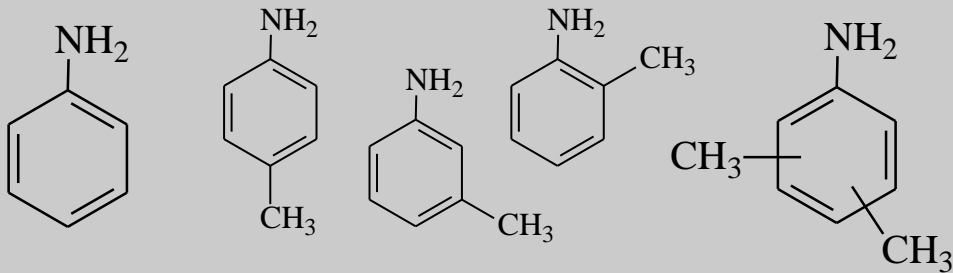
NMA and surrogate fuels

N-Methylaniline (NMA)



Production in Russia – approx. 80 000 tons per year. No significant change was observed after NMA was banned (!)

Analogs:

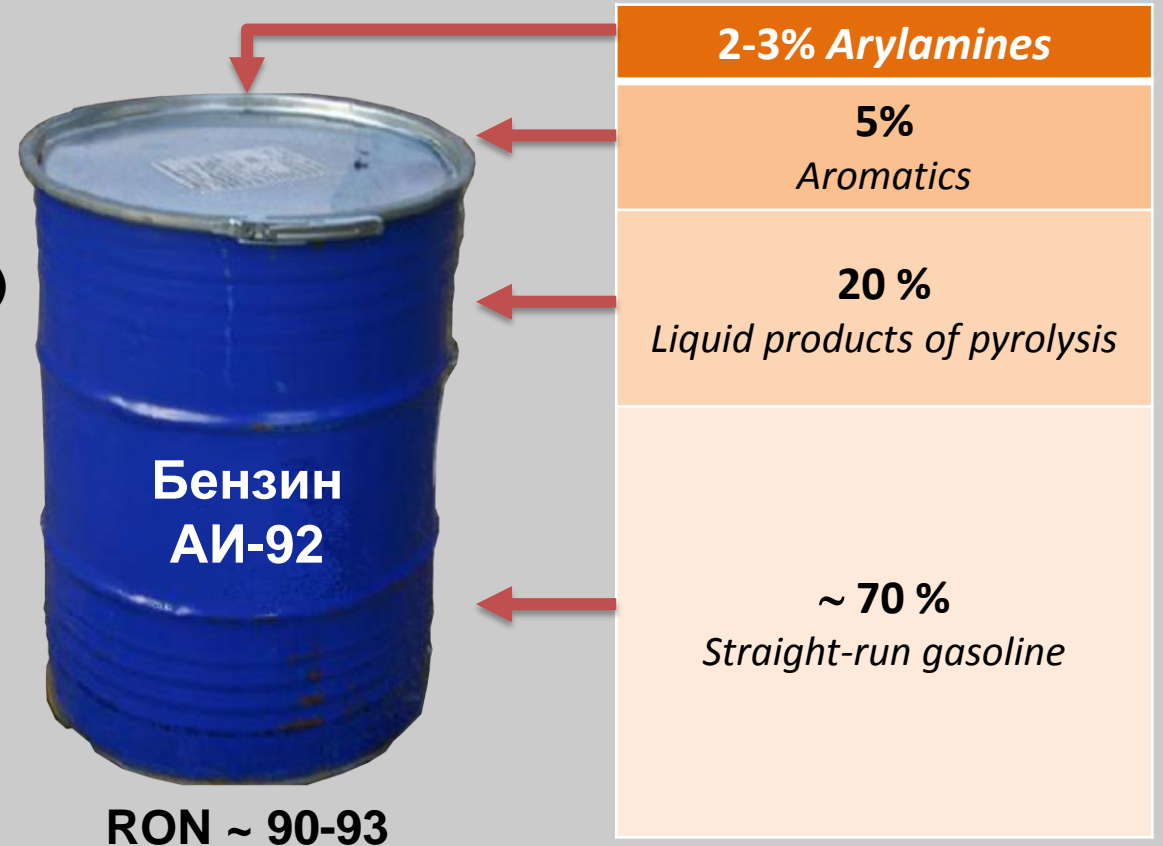


Aniline

Toluidines

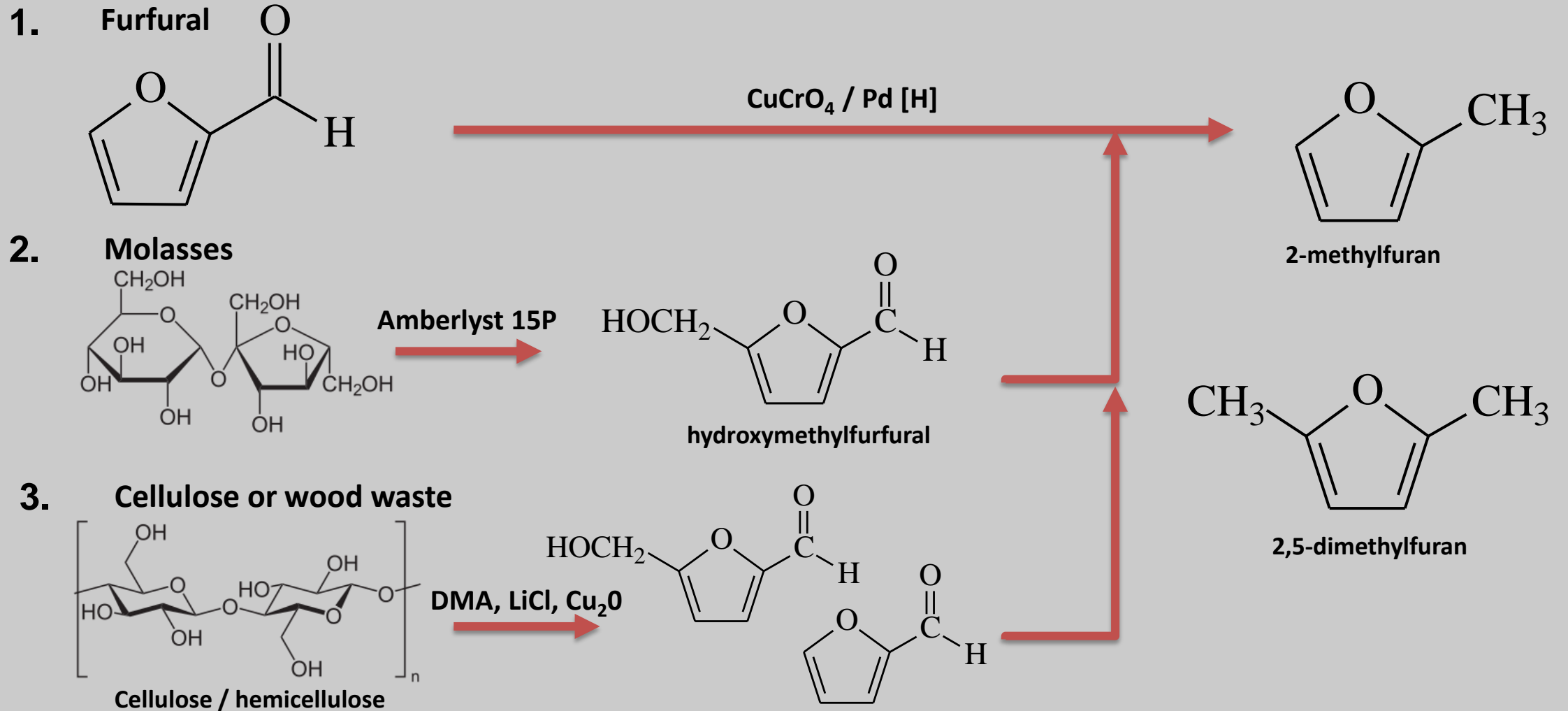
Xylidines

Typical composition of surrogate blend:





Production of MF and DMF





Real-world application

Effect on physical and chemical properties of gasoline

	MF / DMF	MTBE	Ethanol
Octane number	OK	OK	OK
Corrosion activity to metals	OK	OK	Not OK
Influence on rubber	OK	OK	Not OK
Water extraction	OK	Not OK	Not OK
Distillation curves	OK	OK	OK
Vapor pressure	OK	Not OK	OK
Washed and unwashed gum	OK	OK	OK
Oxidation stability	Not OK	OK	OK



Real-world application

Effect on oxidation stability

	Induction period, min	Gum content after oxidation, mg/100 ml		
		Hexane	Insoluble	Total
Base fuel	> 1500	24	-	24
+ MTBE	> 1500	14	-	14
+ MF	335	943	801	1744
+ DMF	108	1098	704	1802

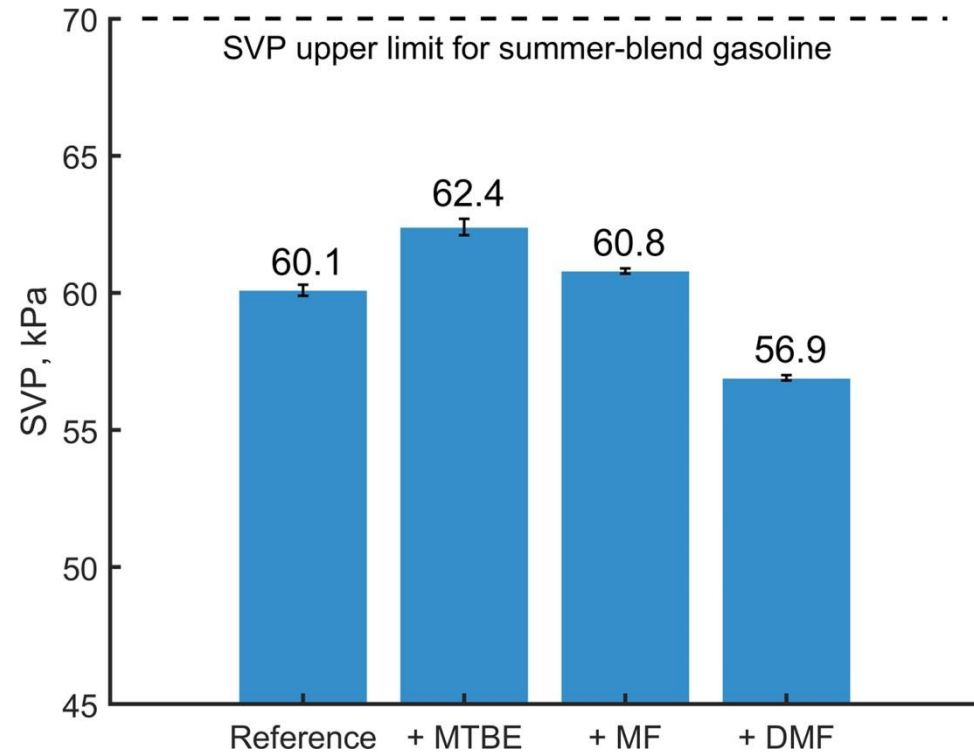
Seek for effective antioxidant



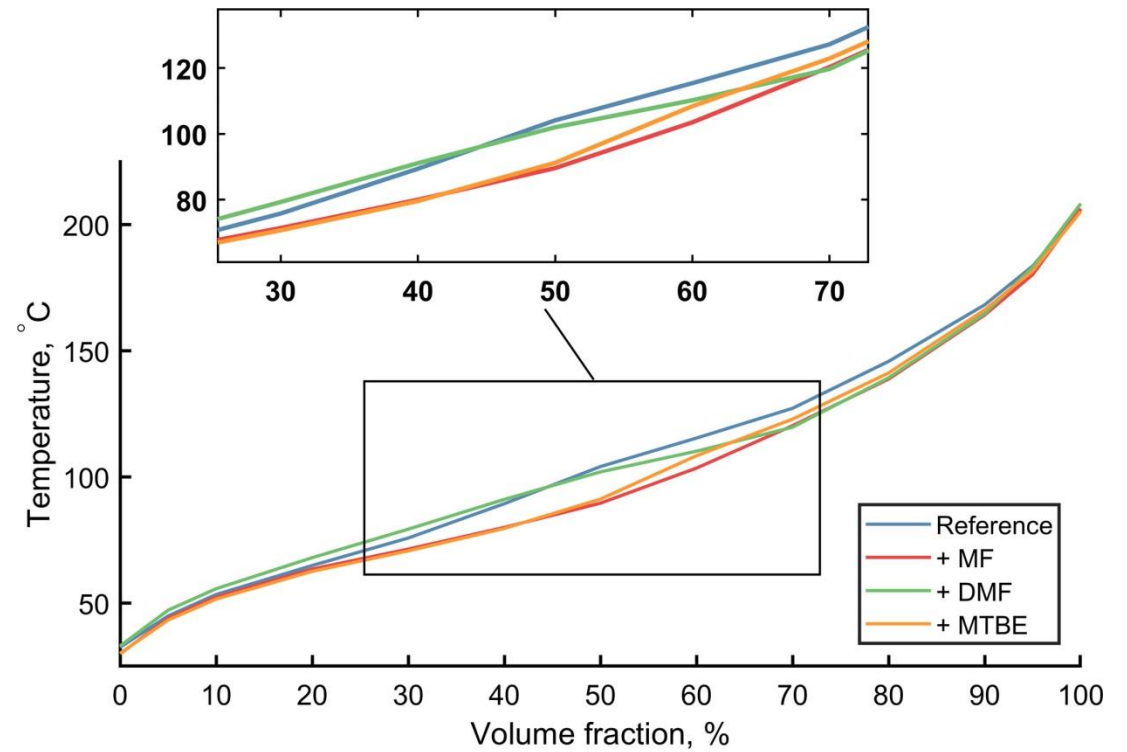


Real-world application

Effect on vapor pressure



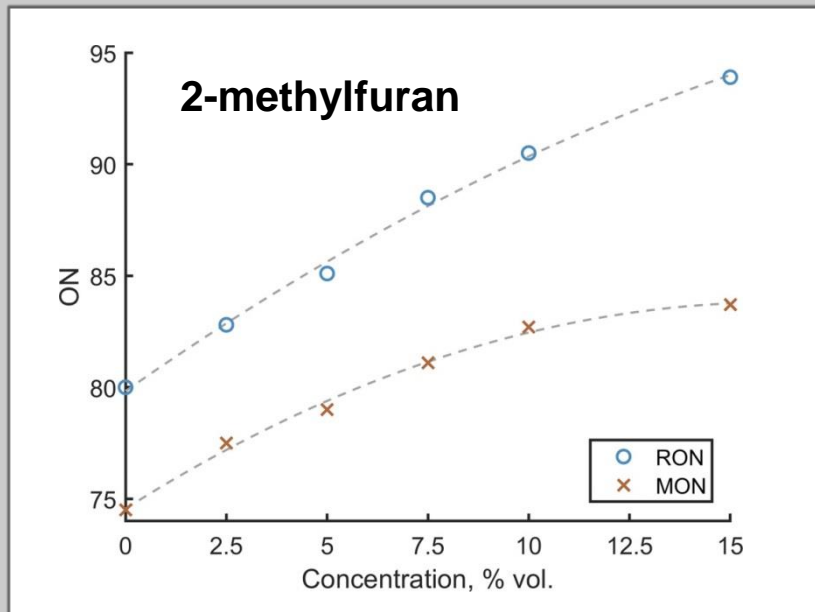
Effect on distillation curves



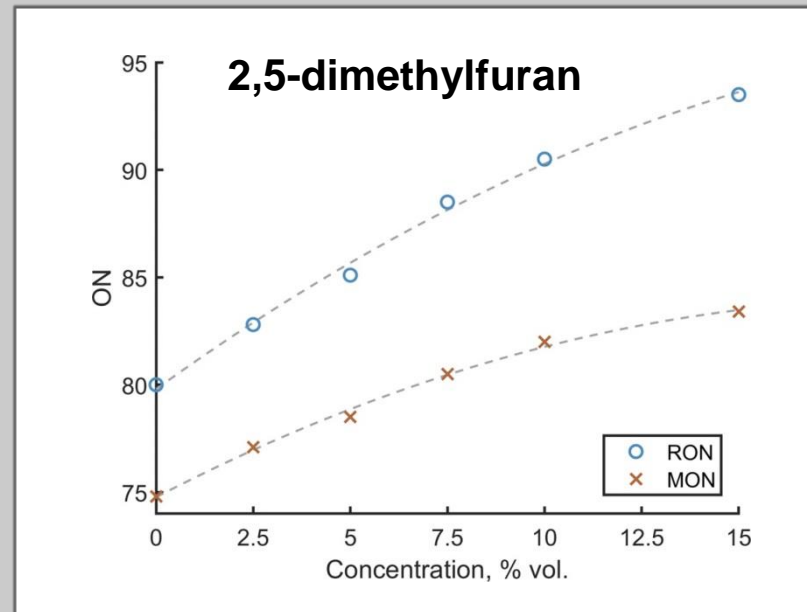


Real-world application

Octane number of blends



bRON = 172 ... 188



bRON = 170 ... 188



Real-world application

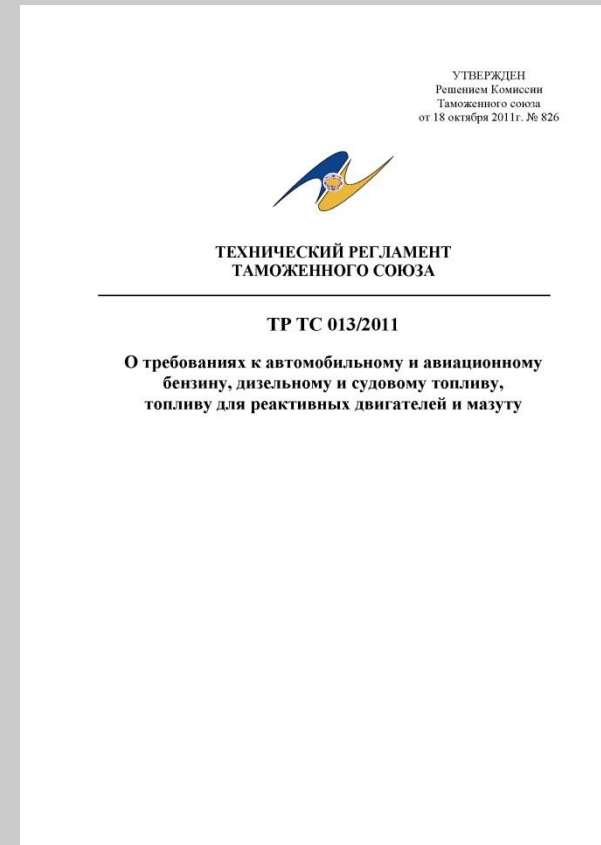
Legal status

MF and DMF meet the requirements of the Technical regulations of the Customs Union.

Section:

«Other oxygenates with a boiling point below 210 degrees»

Maximum content – 10 %vol.





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Thank you!

Mikhail Kotelev

Gubkin University

kain@inbox.ru

Mobile: +7 926 014 91 66

65 Leninsky Prospekt, Moscow, 119991, Russia

<http://www.gubkin.ru>

