

S. NIKEZIĆ, B. NEDELJKOVIĆ

Zastava Diesel Plus – the New Product of Autochemistry

Filterability of diesel fuels during the wintertime can be significantly improved by adding additives. This paper shows research results on finding adequate additives and their ratios in diesel fuels. In cooperation with the additive producer, German company BASF, Mechanical College in Belgrade and the Central Laboratory of "Zastava- automobili" a.d., the department of "Spare parts" initiated the production of ZASTAVA DIZEL PLUS, a product used for improving filterability so that the solidification point of fuel reach -40° C.

Keywords: diesel fuel, filterability, and additives

1. INTRODUCTION

It is not a problem anymore to start heavy trucks, busses, locomotives, passenger and other diesel vehicles in cold winter days.

In the Zastava department " Spare parts " , we started the production of the new freezing preventive ZASTAVA DIESEL PLUS, that prevents diesel fuel and fuel oil from freezing, by increasing filterability or fluidity.

Yugoslav market had no adequate local manufacturer that could meet the needs of European economic community regarding the field of driving fluids. Products like that appear on the market in relatively small amounts (SHELL, KASTROL) without appropriate certificates, which are very often being forged in Greece, Turkey and Italy, which makes the users a little bit suspicious of its quality.

ZASTAVA AUTOMOBILES a.d – department "Spare parts", in cooperation with the famous German firm BASF and the Central Laboratory, succeeded, after months of research, in producing the freezing preventive ZASTAVA DIESEL PLUS, which is in accord with the highest European quality.

Use: The freezing preventive is used for preventing from freezing of the diesel fuel and fuel oil, in low

Srđan Nikezić, B.Econ.

Zastava automobili, a.d. " Spare parts " dpt.

Dr Branislav Nedeljković, B.Sc.

Zastava automobili, a.d. Central Laboratory dpt.

Kragujevac, Yugoslavia

temperatures, where the solidification point reaches the temperature even up to -40° C.

Chemical composition: ZASTAVA DIESEL PLUS is the mixture of petroleum and complex additives of German firm BASF. The production process is complex and demands accuracy and permanent control. We expect that 100 tons of ZASTAVA DIESEL PLUS can be placed on both local and international market.

This paper is about research in adequate additives and their proportion in ZASTAVA DIESEL PLUS.

2. DIESEL FUEL BEHAVING IN LOW TEMPERATURES

Diesel fuel comes from the middle oil fraction and represents the complex mixture of hydrocarbons.

Linear paraffins are of special importance here, and they influence the reaction of the middle distillate in low temperatures. Depending on conditions of distillation, the nature of crude oil and the final phase of the distillation, n-paraffin with 30 and more C-atoms are present. The presence of n-paraffin in middle distillation is desirable because of their influence upon the Cetane number. On the other hand, n-paraffin has bad influence on diesel fluidity in low temperatures. As the number of C-atoms in n-paraffin increases, its solubleness decreases and the point of melting is rising also.

3. DIESEL FUEL CHARACTERISTICS OVER CP, CFPP AND PP

The behavior of middle distillate in cold is characterized by the Cloud Point (CP) or the Point of blurring, as well as with the Pour Point (PP).

During the cooling of the middle distillate under CP, n-paraffin is being sedimented and the tridimensional net formed, which decides the rheologic behavior of the middle distillate.

PP describes the temperature under which the middle distillate is still fluidable. Cold Filter Plugging Point (CFPP) describes the middle distillate's pumping ability in low temperatures. It shows the temperature under which the diesel fuel, under defined cooling conditions, is still able to come through the metal jig, whose mesh is 45 micron. CFPP lies between CP and PP. It was noticed that in the winter, if the temperatures outside are beyond CFPP, filters for fuel are not being clogged when the diesel engine works. This happens even if the outside temperatures are 2-3°C under CFPP. In Germany it is specified that the diesel's winter quality should have CFPP of -22°C.

4. THE LOWERING OF CFPP AND PP BY USING MDFI-ADDITIVE

For CFPP and PP lowering Keroflux products are used, made by the German firm BASF, named Middle Distillate Flow Improver (MDFI-additive), which represents low molecular polymers with the structure similar to the paraffin with polar connections. MDFI-additives prevent the n-paraffin's crystals from growth by using cocrystallization and bring about the creating of small crystals (figure 1).

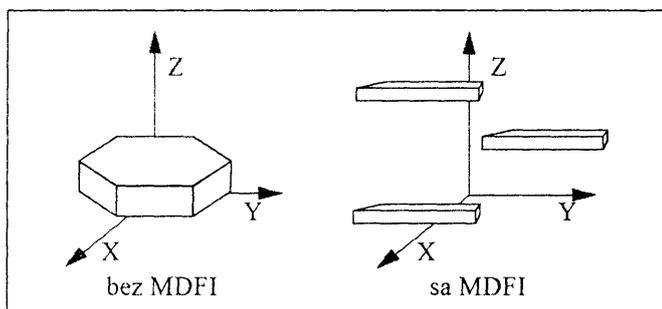


Figure 1

In the basis of these additives are the copolymers of ethylene and vinyl ether, such as vinyl acetate or vinyl propionate.

MDFI additives are not universal. The selection of the optimal type and the dose is based on laboratory researches (measuring of MDFI) upon the sample of the middle distillate from the given refinery. The values of additives are specific for each country and

depend on the season. There are 2-3 qualities of diesel fuel being produced in Europe, according to the season together with the maintenance of optimal mixture of the middle distillate. At the beginning of the ZASTAVA DIESEL PLUS production we used additives belonging only to the group of MDFI-additives.

5. THE SELECTION OF ADDITIVES FOR ZASTAVA DIESEL PLUS

The laboratory researches in the Central Laboratory of "Zastava automobili", a.d. and in the Machine Faculty in Belgrade, together with the parallel researches in BASF, in the given sample of the same quality, we reached the optimal composition for the type and quantity of additives for ZASTAVA DIESEL PLUS.

These are:

KEROFLUX ES 6100 (MDFI)- polymer based on ethane – aliphatic alcohol in the dissolvent.

KEROFLUX ES 3502 (WASA)-Wax Anti Settling Additive- paraffin dispergator, the derivate made of the ethoxydiaminotetra-vinegar acid and tetramids in the dissolvent, which serves to stop the n-paraffin crystallization.

Keroflux ES 6100 is soluble in aliphatic and aromatic dissolvents, but in all proportions, dissoluble in water. It improves obviously the fluency of middle distillates in low temperatures. It works as the crystallizing modifier of n-paraffin. It prevents the forming of the coherent net made of paraffin crystals with the noticeable reduction of CFPP and PP of middle distillates. It is being added to the middle distillates in quantity 50-100 PPM. The real quantity depends on the content of the middle distillate, which is described by:

the Cloud Point (CP), the Boiling Point, the type and the quantity of the paraffin and other parameters. For direct dosage with the middle distillates the most appropriate temperature is 40-50°C and the temperature of the middle distillate of 30-35°C. It is mixable with other qualities of Keroflux.

n-Paraffin crystal size:

Without MDFI:	0,1-1 mm
With MDFI:	0,02-0,05 mm
with MDFI and WASA:	0,005-0,02 mm

Synergetic effect after adding of additives MDFI and WASA diesel oil is showed in the figure 2.

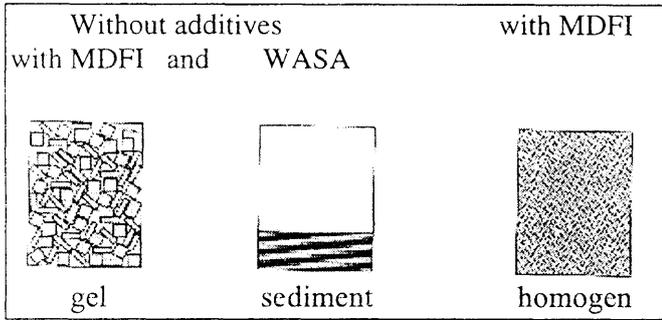


Figure 2.

On the diagram of CFPP-doses ppm, it is showed the increase of diesel oil fluidity with usage of Keroflux ES 6100 and the synergetic acting of Keroflux ES 6100 and 150 ppm Keroflux ES 3502 and on this diagram we can see the influence of additives upon CFPP reduction.

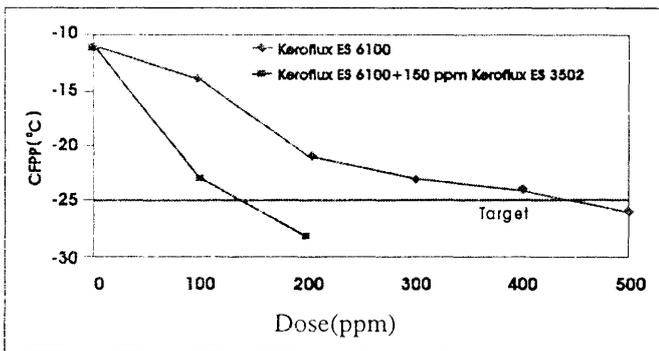


Figure 3.

On the Machine Faculty in Belgrade, in Laboratory for fuel and combustion testing, the testing of Keroflux ES 6100 on diesel oil in low temperatures was conducted.

The results of that testing are given in the table 1.

Table 1.

	D2 without additive	D2 with additives (0,5ml+500ml)*	D2 with additives (0,5ml+250ml)**
the first measuring	-6	-9	-11
the second measuring	-6	-8	-10

* Additive concentration on the diagram given in percents, that is as additive concentration of 0,01%

** Additive concentration is given on the diagram in percents, that is as additive concentration of 0,2%

The decrease of temperature filterability by using additives is shown on the figure 4.

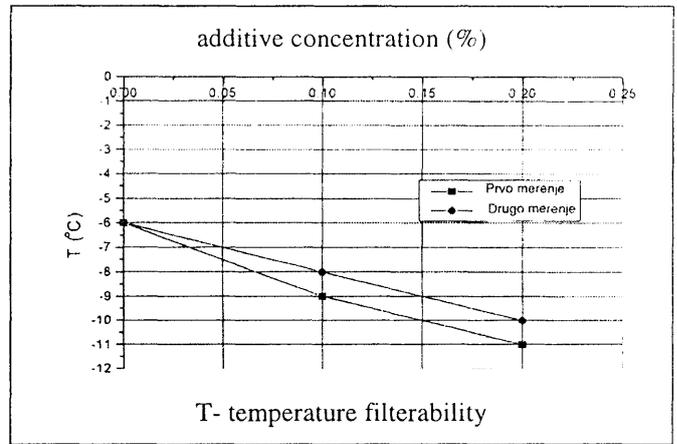


Figure 4.

The diagram, given on the figure 5., shows the additive efficiency.

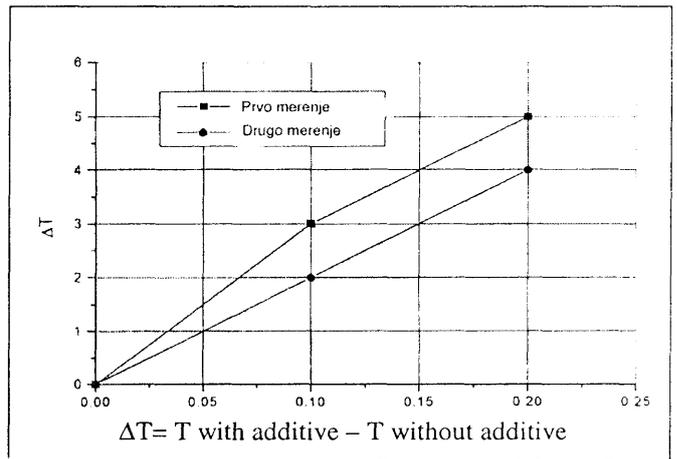


Figure 5.

BASF conducted the testing of CFPP with ZASTAVA DIESEL PLUS samples, produced in Zastava, on diesel fuels produced for Eastern and Western Europe:

the reference I is referring to Eastern Europe winter diesel

the reference II is referring to Western Europe winter diesel

CFPP (EN 116)

Reference I : diesel fuel for Eastern Europe

Combination : Keroflux ES 6100 + Keroflux ES 3502

CP	- 4,3°C
CFPP	- 7°C
CFPP Wanted	- 25°C

Doze Keroflux ES 6100	Doze Keroflux ES 3502				
	Ppm: 75	100	150	200	250
100 ppm*			-24		
100 ppm*		-17			
150 ppm*			-25		
200 ppm*			-28		
200 ppm*				-27	
250 ppm*					-28
300 ppm*			-28		
400 ppm*			-28		

CFPP (EN 116)

Reference II : diesel fuel for Western Europe

Combination : Keroflux ES 6100 + Keroflux ES 3502

CP	- 4,8°C
CFPP	- 6°C
CFPP Wanted	- 15°C

Doze Keroflux ES 6100	Doze Keroflux ES 3502				
	Ppm: 75	100	125	150	175
150 ppm*				-18	
150 ppm*	-19				
200 ppm*				-19	
200 ppm*		-20			
250 ppm*			-28		
300 ppm*				-24	
350 ppm*					-30
500 ppm*				-26	

CFPP diesel fuel for West Europe could be reduced after adding additives 350 ppm of Keroflux ES 6100 (1400 ppm ZASTAVA DIESEL PLUS) and 175 ppm of Keroflux ES 3502 to - 30°C. In comparison to the “blind” value in matches the improvement of 24 °C under the same total dosage comparing to the usage of Keroflux ES 6100 itself.

It matches the increase of 5°C that cannot be reached only by dosing of MDFI.

6. CONCLUSION

The filterability temperature of diesel fuel can be relevantly reduced by adding appropriate types and quantities of additives. A new product, ZASTAVA DIESEL PLUS, of highest quality, is produced with the use of local knowledge and equipment and through market research, monitoring of modern world achievements, and making connections with the famous European producers.

A new sector for production of game products in the field of autochemistry and autocosmetics, as a part of programme for diversification and employing of labour. The production is conducted on modern equipment and the market requirement referring to the lowest levels of ecotoxicity is being obeyed. The quality of input raw materials and the finished product is guaranteed by the Central Laboratory.

Zastava has the potential concerning cadres, as well as the technical and laboratory potential, that follows the European and world achievements, in the direction of development of products of quality. It also has the power to implement these products on the local and international market.

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