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**MONITORING OF RAPESEED OIL QUALITY WITH RESPECT
TO THEIR UTILIZATION AS A MOTOR FUEL**

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To evaluate effect of production processes on standardized properties the samples from typical small-capacity oil mills and one industrial production plants of rapeseed oils were took-off. At the same time the storage experiment for rapeseed oils with additive of 200, 400 and 600 ppm of antioxidant was established including evaluation of oxidation stability. The results have proved that critical points of the process of rapeseed oils acquisition are contamination caused with ash-generating elements as phosphorus, magnesium, calcium and total contamination. The monitoring has brought necessary knowledge for optimization of rapeseed oils acquisition process, their distribution and importance of antioxidants utilization. The monitoring also is a basis for establishing of necessary quality control in rapeseed oils production.

1. Introduction

The number of decentral oil mills is increasing rapidly. The rapeseed oil can be also utilized as a fuel for modified diesel engines. For a reliable operation of adapted diesel engines, the rapeseed oil fuel has to fulfil special quality requirements, which are defined in the technical standard [1, 2, 3, 4]. It was the purpose of this work to investigate influences of the whole production process on rapeseed oil fuel properties. To survey the rapeseed oil quality, available on the market, oil samples were periodically taken from several oil mills and analyzed.

2. Objects and methods

In order to determine and compare the quality of rapeseed oils, there were taken out the testing batches from six decentralized production units and one industrial oil plant (see Table 1). The subsequent analyses of testing samples have been carried out by the method enabling the comparison with specification of required limit

values of technical standard ČSN 65 6516 „Fuels for vegetable oil compatible combustion engines – Fuel from rapeseed oil“ [5].

Table 1. Characteristics of test samples collection of rapeseed oils and scope of made analyses

Performance in rapeseed oil	Characteristics of oil pressing and treatment		Sample number	Analysis in laboratory	Analysis in accredited laboratory
190 kg.h ⁻¹	one-stage cold, filtration with manual cleaning and filter fabric		1	density (15 °C) water content acidity number total content of impurities phosphorus content Mg+Ca content iodine value oxidation stability	all parameters pursuant to ČSN 65 6516 without ability of ignition
340 kg.h ⁻¹	one-stage cold, sheet automatic filter		2		as the sample 1
310 kg.h ⁻¹	two-stage cold, sheet automatic filter		3		-
410 kg.h ⁻¹	two-stage cold, sheet automatic filter		4		-
530 kg.h ⁻¹	two-stage cold, sheet automatic filter		5		-
530 kg.h ⁻¹	two-stage cold, whitening sheet automatic filters		6		as the sample 1
930 kg.h ⁻¹	hot, removal of mucus and neutralization, sheet automatic filter		7		-
11700 kg.h ⁻¹	pressing and extraction	degumming	8	water content	-
		whitening	9	acidity number	-
		refinement	10	P-content oxidat. stability	-

3. Results and discussion

The measured characteristics have shown the great difference in quality of testing samples (see Fig. 1 – 8). In all manufacturing plants there was processed rapeseed, which fulfilled the qualitative purchase conditions. It helped as well to ensure in decisive extent the meeting of demands for water content, acidity number and oxidative stability in assessed oil plants. However, to the critical points in the process of rapeseed oil obtaining, belong the contamination by phosphorus, metals of second group (magnesium and calcium) and total content of contamination from rapeseed solid residues. The consequential detailed investigation of reasons of this state enabled to determine the factors, which caused this contamination. Therefore, it is possible to state as follows:

Behind the one-stage cold pressing of rapeseed, which decreased the level of contamination caused by phosphorus, magnesium and calcium under limit values of technical standard ČSN 65 6516 [5], it is necessary to place the second safety degree of filtration with filtration ability of particles in line filter max. 1 μm .

The two-stage cold pressing and also hot pressing, resp. industrial processing with extraction, is always connected with content of phosphorus and very often also magnesium and calcium in rapeseed oil over limit values. Therefore, it must always follow the removal of mucus, eventually neutralization or other operations, e.g. whitening or filtration through hydrophobic membranes, which however lead to cost increase and that's why it is necessary to select them carefully. In respect to removal of mucus, besides of conventional procedures, it is possible to recommend so-called „superdegumming“. Before, there are combined the acid and water and thereby comes not only to high grade of phospholipide separation, but also to considerably lesser occurrence of water. It can be applied Total Degumming Process, which can be used not only for raw oils, but also for oils with mucus removed by water and it is based, in principle, on addition of acid and lye with consecutive separation. During this process the phospholipides are almost completely taken away. It is also possible to use the enzymatic process for removal of mucus „EnzyMax Degumming“.

Oxidation stability is other important indicator determining suitability of rapeseed oil utilization as a fuel from the storage point of view and with it related degradation. The continuous of rapeseed oils storage test with preparation Baynox 200, 400 a 600 ppm in PVC vessels with access of air and stored in unheated room illuminated only by daily light in the course of 420 days is shown on fig. 9.

Monitoring brought the essential evidences and knowledge for optimalization of rapeseed oils obtaining and their distribution as the motor fuels. It forms also the starting basis for creation of necessary quality assessment. Its implementation into practice represents necessary condition for maintenance of stable and high quality of motor fuel manufactured from the rapeseed oil.

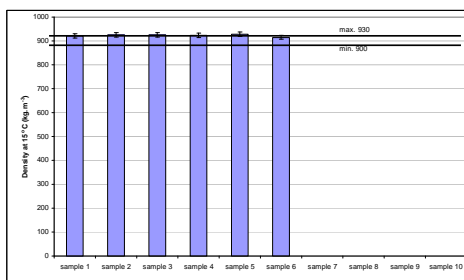


Fig. 1. Density of rapeseed oils test samples

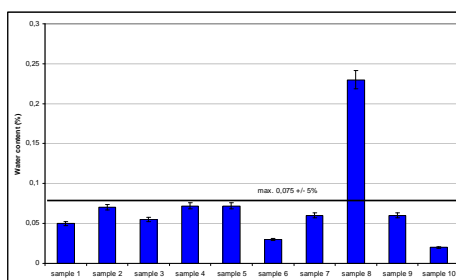


Fig. 2. Water content in rapeseed oils test samples

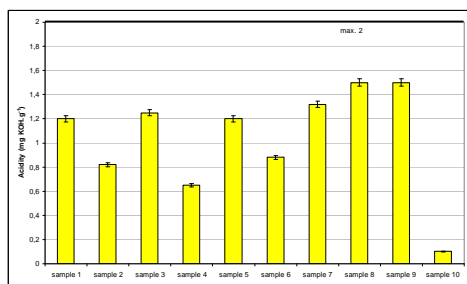


Fig. 3. Acidity number of rapeseed oils test samples

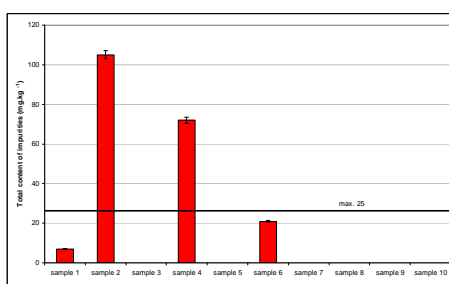


Fig. 4. Total content of impurities in test rapeseed oils test samples

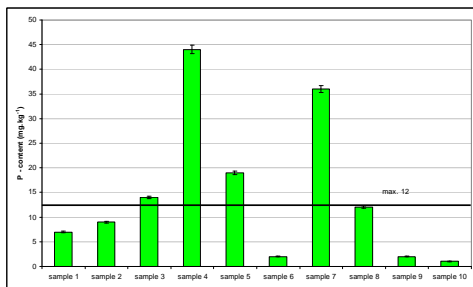


Fig. 5. P - content in rapeseed oils test samples

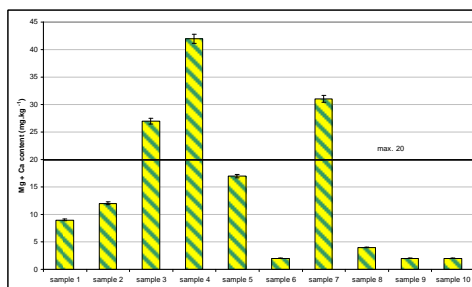


Fig. 6. Mg+Ca metal content (II. group) in rapeseed oils test samples

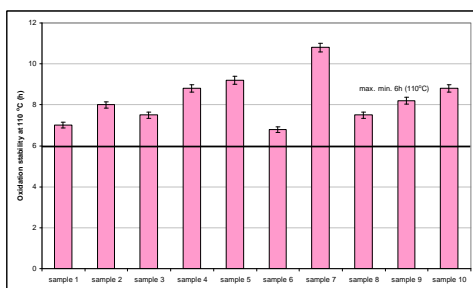


Fig. 7. Oxidation stability of rapeseed oils test samples

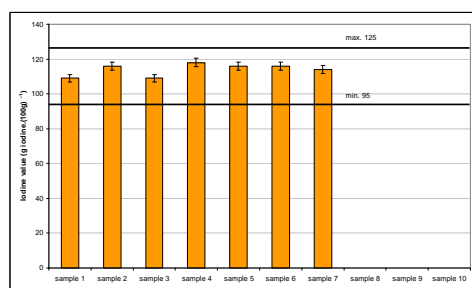


Fig. 8. Iodine value of rapeseed oils test samples

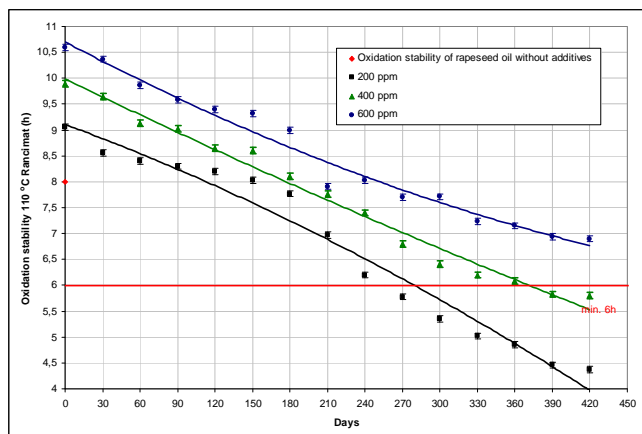


Fig. 9. Relations among oxidation stability of rapeseed oils with 200, 400 and 600 mg.kg⁻¹ antioxidative additive Baynox, its quality correspond to the sample No. 2 taken in conformity with data in tab. 1

4. Conclusions

To assess effect of production process for standardized properties the samples were taken-off from the six referential decentralized and one industrial production plants for rapeseed oils. Their properties limited by technical standard for rapeseed oils as a fuel were determined in laboratory. Further the long-term investigation of oxidation stability change was started in storage trial of rapeseed oils with additive of 200, 400 and 600 ppm of antioxidant Baynox. The results have shown that critical points of that process of rapeseed oils acquisition are contamination by the ash-producing elements, i.e. phosphorus, magnesium, calcium and total pollution. Not only in hot pressing but also in the double-stage cold pressing of rapeseed it is necessary reduction of the ash-producing elements through other technological operations as degumming, neutralization, bleaching. It had been proved the unambiguously positive effect of the antioxidation additive Baynox, when 200 ppm addition caused increasing of the oxidation stability of rapeseed oil grown at least 6 hours immediately after pressing from 8 hours to 9.05 hours and not until after 270 days decreased under limit value 6 hours. With using of addition 400 ppm Baynox decreased oxidation stability under 6 hours not until after 390 days of storage. With addition 600 ppm Baynox the oxidation stability of rapeseed oil even after 510 days of storage makes 6.5 hours. The monitoring brought the necessary knowledge for the process of the rapeseed oils acquisition optimization and their distribution for motor application. The monitoring also is a basis for establishing of necessary controlling of the rapeseed oils production quality.

5. References

- [1] DIN V 51605 “Kraftstoffe für pflanzenöltaugliche Motoren – Rapsölkraftstoff – Anforderungen und Prüfverfahren, Juli 2006
- [2] REMMELE, E. Herstellung von Rapsölkraftstoff in dezentralen

Ölgewinnungsanlagen. I. Auflage. Gülzow, Fachagentur Nachwachsende Rohstoffe e.V. November 2007. 83 s.

- [3] JEVIČ, P., ŠEDIVÁ, Z., PŘIKRYL, M. Monitoring of winter rape variety composition quality for raw material utilization. In. Trends in Agricultural Engineering 2007 (3rd International Conference TAE). Czech university of Life Science Prague, 2. – 14.9.2007, s. 189 – 194
- [4] REMMELE, E., GASSNER, T., STOTZ, K. Quality assurance for rapeseed oil fuel DIN V 51605 from small scaled oil mills. In. Status and perspectives of sustainable development of biogenic fuel. Proceedings of the 8th international seminar, Techagro 2008, Brno, s. 66 – 75
- [5] ČSN 65 6516 “Automotive fuels – Fuels for vegetable oil compatible combustion engines – Fuel from rapeseed oil – Requirements and test methods (Motorová paliva – Řepkový olej pro spalovací motory na rostlinné oleje – Technické požadavky a metody zkoušení). December 2007

Monitorování jakosti řepkových olejů se zřetelem k jejich využití jako motorové palivo

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Pro posouzení vlivu výrobních procesů na normované vlastnosti se odebraly vzorky z typických malokapacitních olejáren a jedné průmyslové výrobní řepkových olejů. Současně byl založen skladovací pokus řepkových olejů s přísadou 200, 400 a 600 ppm antioxidantu a hodnocena oxidační stabilita. Výsledky ukázaly, že kritickými body procesu získávání řepkových olejů jsou kontaminace popelotvornými prvky fosforem, hořčíkem, vápníkem a celkové znečištění. Monitorování přineslo nezbytné poznatky a znalosti pro optimalizaci procesu získávání řepkových olejů, jejich distribuci a důležitost použití antioxidantů. Je rovněž podkladem pro vytvoření nezbytného řízení kvality výroby řepkových olejů.

МОНИТОРИНГ КАЧЕСТВА РАПСОВОГО МАСЛА С ТОЧКИ ЗРЕНИЯ ЕГО УТИЛИЗАЦИИ В ВИДЕ МОТОРНОГО ТОПЛИВА

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Для обсуждения воздействия производственных процессов на нормированные показатели, отобраны пробы типических децентрализованных маслобойней и одного промышленного производства рапсового масла. В том числе создан опыт хранения рапсового масла с присадкой 200, 400 и 600 ppm антиокислителя и оценена оксидационная стабильность. Как показали результаты, критическими точками получения рапсового масла являются контаминация золообразующими элементами фосфором, магнием, кальцием и суммарным содержанием загрязнений. Мониторинг принёс необходимое значение для оптимизации процесса производства рапсового масла, его дистрибуцию и важность применения антиоксидантов. Результаты представляют собой тоже данные для создания необходимого управления качеством производства рапсового масла.