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STUDIES OF ALCOHOLS CONTENT IN WINTER WINDSCREEN WASHING LIQUIDS

BADANIA ZAWARTOŚCI ALKOHOLI W ZIMOWYCH PŁYNACH DO SPRYSKIWACZY

Abstract: Analyses of 12 winter windscreen washing liquids available on the home market were performed. Methanol, ethanol and 2-propanol were determined. Results of the investigations indicated that in the all samples ethanol was present. In four samples methanol was also determined. One product contained 2-propanol. The total alcohols content in all samples was calculated. Alcohols content in winter windscreen washing liquids was between 30÷50%.

Keywords: windscreen washing liquids, cabin air quality, methanol, ethanol, 2-propanol

Indoor air quality is more and more important due to the time people spend indoors (more than 80% of their time) [1-3]. As well as indoor air quality in various buildings, air quality in mobile cabins (CAQ - Cabin Air Quality) including cars, trains, buses, aircrafts and subway is also important [3, 4].

In big city agglomerations people have spent more time in their cars. It is a result of the increase in numbers of vehicles as well as a bad road organization. Hence, the main roads in cities in the rush hours are full of cars stuck in a traffic jam.

According to accessible literature, in car cabin the volatile organic compounds such as acetone, ethanol, limonene, 2-propanol, 2-butanone are present very often [3, 5]. Ethanol and limonene are those, whose content in cabin air is the biggest. They are often ingredients of car cosmetics such as waxes, air-freshners, cleaning and conditioning agents. Windscreen washing liquids rank among this group of products. They may contain ethanol, 2-propanol and methanol. The above compounds have harmful impact on a human body by causing the symptoms such as sickness, irritation of an eye, nose or throat mucosa. Ethyl alcohol decreases the motor and muscle coordination and reaction time becomes slower, what may endanger the road safety. Both ethyl and methyl alcohols badly affect the eyesight and methyl alcohol may lead to irreversible damage of the eyesight [6].

Materials and methods

The studies of alcohols contents in the windscreen washing liquids were performed by using gas chromatography method. The subject of examinations was 12 of winter windscreen washing liquids available on the home market.

The samples of analyzed product (5 mm³) were injected into 1114 cm³ containers, tightly closed with the screw caps containing the silicon membranes. The samples were evaporated in a thermostat chamber at the temperature of 50°C. Next, they were stabilized at the room temperature for 30 minutes. After equilibration, the gas samples of 1 cm³ volume were drawn with a Hamilton gas-tight syringe and analyzed on a gas

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chromatograph equipped with flame-ionization detectors (FID). The qualitative and quantitative analyses of windscreen washing liquids components were performed using a CHROM 5 gas chromatograph with a FID detector. The chromatograph was provided with a steel chromatographic column of 1 meter long of 3 mm inside diameter packed with Chromosorb 102, (80÷100 mesh). The following temperatures were applied: column 100°C, injector 120°C, detector 150°C. Nitrogen ($40 \text{ cm}^3 \cdot \text{min}^{-1}$) was used as the carrier gas.

Identification was performed with the aid of methanol, ethanol and 2-propanol standards (standards for GC purity $\geq 99.9\%$). The identification of the alcohols was confirmed using an Agilent 6890N gas chromatograph with a 5973N mass selective detector.

Quantitative analyses of the windscreen washing liquids components were performed on the CHROM 5 gas chromatograph with a FID detector. The apparatus was calibrated using the standard gas mixtures prepared in the same containers and conditions in which the tested samples were prepared. Correlation coefficients of calibration curves for determined compounds were in the range of $0.9953 \div 0.9967$. Alcohols content in the examined products was calculated.

Results and discussion

Results of the quantitative analyses of alcohols content in the examined samples are given in Table 1.

Table 1
Results of the determination of alcohols content in products

Product	Substance	Content [% vol.]	Standard deviation SD	Coefficient of variation RSD [%]
WL1	ethanol	34.90	0.97	2.79
WL2	methanol	4.57	0.14	3.15
	ethanol	34.41	0.21	0.62
WL3	methanol	38.66	1.30	3.35
	ethanol	6.00	0.21	3.53
WL4	ethanol	37.09	1.39	3.75
WL5	methanol	3.92	0.16	4.06
	ethanol	31.53	1.08	3.42
WL6	ethanol	48.61	1.74	3.57
WL7	methanol	8.87	0.12	1.35
	ethanol	12.37	0.21	1.71
	2-propanol	11.34	0.43	3.77
WL8	ethanol	35.02	0.92	2.64
WL9	ethanol	35.14	0.56	1.60
WL10	ethanol	40.41	0.37	0.91
WL11	ethanol	42.61	0.37	0.86
WL12	ethanol	41.75	0.42	1.02

Results of the investigations indicated that in the all samples ethanol was present. Its content in the most winter windscreen washing liquids was about 30÷50%. Only in two samples ethanol content was lower and averaged 6.00% for the sample WL3 and 12.37% for the sample WL7.

In four samples methanol was determined. Methanol content in sample WL3 was very high and achieved nearly 40%. In our opinion using of this product is dangerous. The large amount of methanol has harmful effect on human health, especially on sight. In the three other samples (WL2, WL5 and WL7) methanol content was considerably lower. Additionally in the WL7 sample, 2-propanol was identified. Its content in this product was about 11%.

The summary alcohols content in the samples was calculated. Results are presented in Figure 1. Alcohols content in winter windscreen washing liquids was between 30÷50%. In the majority of products this value varied from 30 to 40%. The maximum alcohols content was found in samples WL3 (44.66%) and WL6 (48.61%).

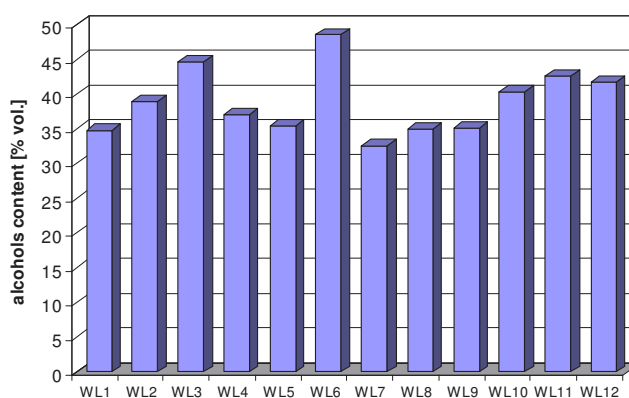


Fig. 1. Summary alcohols (methanol, ethanol and 2-propanol) content in winter windscreen washing liquids

The accuracy of the described method was determined on the basis of calculation of alcohols recovery from winter windscreen washing liquids of strictly determined composition. For this purpose composed four types of model washing liquids with different content of methanol, ethanol and 2-propanol. Alcohols content and composition of the model windscreen washing liquids were selected in the way to respond to the commercial product composition. Their characteristics and alcohols recoveries are given in Table 2. The mean alcohols recovery for the analysed products was 101.49%.

Table 2
Data of accuracy and precision of determination method of alcohols content in windscreen washing liquids

Model windscreen liquid	Substance	Content [% vol.]	Recovery [%]	Standard deviation SD	Coefficient of variation RSD [%]
TWL1	methanol	10	101.86	1.91	1.87
	ethanol	10	94.13	3.10	3.30
	2-propanol	10	94.76	2.38	2.55
TWL2	methanol	40	111.00	0.62	0.56
	ethanol	5	96.85	2.50	2.59
TWL3	methanol	5	106.43	2.88	2.71
	ethanol	40	103.36	0.63	0.61
TWL4	ethanol	50	103.50	0.50	0.48

Precision of the method was determined by evaluation of repeatability of the results calculating the standard deviation and a coefficient of variation. The coefficients of variation for the obtained results were below 5%.

Conclusions

The analyses of 12 winter windscreen washing liquids available on the home market were performed.

Summary alcohols content in winter windscreen washing liquids was between 30÷50%. In the tested products three alcohols (methanol, ethanol and 2-propanol) were identified. Ethanol was present in the all samples. In four samples methanol was determined. Its content was very high (39%) in one product. One sample contained about 11% of 2-propanol.

The described methodology may be used to control the quality of windscreen washing liquids and may be used to evaluation of cabin air quality. The method is repeatable and accurate. The mean alcohols recovery was 101.49%.

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BADANIA ZAWARTOŚCI ALKOHOLI W ZIMOWYCH PŁYNACH DO SPRYSKIWACZY

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Abstrakt: Przedmiotem badań było 12 rodzajów zimowych płynów do spryskiwaczy dostępnych na rynku krajowym. W badanych produktach zidentyfikowano i oznaczono ilościowo etanol, metanol i 2-propanol. Wyniki badań wskazują, że we wszystkich badanych produktach obecny jest etanol. Metanol zidentyfikowano w czterech próbkach. Jeden z produktów zawierał 2-propanol. Obliczono sumaryczną zawartość alkoholi w próbkach. Mieściła się ona w granicach 30÷50%.

Słowa kluczowe: płyny do spryskiwaczy, jakość powietrza w kabinach, metanol, etanol, 2-propanol