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IDENTIFICATION AND SAFETY ASSESSMENT OF GOODS FROM POLYSTYRENE

Abstract: It is established that the studied samples of polystyrene goods contain different types of organic and macromolecular structures. The ratios of substances in the composition of polyethylene materials were identified using the methods of IR spectroscopy, viscometer, density and PTR.

Key words: Commercial nomenclature of foreign economic activity, classification, polyolefin, IR spectroscopy, viscometer, density and PTR.

Language: English

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Introduction

Goods manufactured by the chemical and as well as with the related industries have more significant share of products and usually are the subject of export-import trade operations. There are raw materials and various substances among them which are used in industrial production, as well as a large number of

industrial and domestic products. In the commodity nomenclature of foreign economic activity of the Republic of Uzbekistan, these goods are concentrated in sections V-VII (groups 25-40).

The polystyrene which has been researched is classified in heading 3903 TN [1].

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3903	Styrene polymers in primary forms:
	- polystyrene:
3903 11 000 0	- foaming
3903 19 000	- other:
3903 19 000 1	--- freon-resistant
3903 19 000 9	--- other
3903 20 000 0	- styrene acrylonitrile copolymers (SAN)
3903 30 000 0	- copolymers of acrylonitrile butadiene styrene (ABS)
3903 90	- other:
3903 90 100 0	- a copolymer of only styrene and allyl alcohol, with an acetyl number of 175 or more
3903 90 200 0	- brominated polystyrene containing 58 wt.% or more, but not more than 71 wt.% bromine, in one of the forms mentioned in Note 6(b) to this group
3903 90 900 0	- other

This heading also covers polystyrene and styrene copolymers. The most important copolymers of styrene are copolymers of styrene acrylonitrile (SAN), copolymers of acrylonitrile butadiene styrene (ABS), copolymers of styrene butadiene. Most copolymers of styrene and butadiene with a high content of butadiene meet the requirements of note 4 to group 40 and therefore are included in group 40 as synthetic rubber. [1]

In the examination of these materials a large role belongs to their identification. This is important not only for raw materials and semi-finished products, but also for finished products, since they are all characterized by a diverse composition.

Due to its valuable properties, polystyrene is used to produce a wide range of consumer goods. Like hard plastic, it is often used in products requiring transparency, such as food packaging and laboratory glassware. In combination with various dyes, additives or other plastics, polystyrene is used for the manufacture of appliances, electronics, automotive parts, toys, garden pots and other equipment.

2 MATERIAL AND METHODS

Polystyrene is also converted into a foam called polystyrene foam (EPS) or extruded polystyrene (XPS), which is valued for its insulating and cushioning properties. Expanded polystyrene can contain more than 95 percent of air and is widely used for insulation of homes and household appliances, lightweight protective packaging, surfboards, packaging for catering and food products, automotive parts, road stabilization systems and etc.

Non-foamed polystyrene is a colorless, transparent thermoplastic material that is widely used in the electrical and radio industries. It is also used in packaging, for example, food and cosmetics. It is also used in the manufacture of toys, watch cases and phonograph records.

Styrene and acrylonitrile (SAN) copolymers, which have high tensile strength, are well formed and have high chemical resistance, are used to make cups and glasses, typewriter keys, refrigerator parts, oil filter containers and some items of kitchen equipment. Copolymers of acrylonitrile, butadiene and styrene (ABS), which have high impact resistance and weather resistance, are used in the manufacture of parts and auxiliary parts of vehicle bodies, refrigerator doors, telephones, bottles, shoe heels, cases and cases of various apparatus and equipment, water pipes, building panels, ships, etc.

The problems of the classification of goods in accordance with the commodity nomenclature of foreign economic activity are common to all types of products. However, it is worth noting that when assigning certain types of goods to high-tech industries (chemical products) to a certain Harmonized system (HS) code, experts have additional difficulties due to the need to use special technological knowledge, which leads to errors in determining the subheading of the goods. [5]

Polystyrene is classified on several bases (Table 1). [2]

Table 1.

By stereoisomer	By the method of obtaining	By appointment
1. Atactic	1. emulsion polystyrene (PSE)	1. high impact polystyrene
2. Isotactic	2. suspension polystyrene (PSS)	2. transparent or general purpose polystyrene
3. Syndiotactic	3. block polystyrene (PSB)	3. extruded polystyrene foam

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Nowdays there are several varieties of polystyrene and all of them have the same formula. The nature of the spatial arrangement of benzene rings relative to the molecular chain distinguish: (table 2)

- atactic (amorphous) polystyrene;
- isotactic polystyrene;
- syndiotactic polystyrene.

Table 2. Physical and chemical and thermal properties of atactic, isotactic and syndiotactic polystyrene

Name	T _m °C (melting)	The density of crystals, g/cm ³	Molecular weight distribution range, x10 ³	T _g °C (glass transition)
Isotactic Polystyrene	240	1,111	150-710 (Toluene, 30 °C)	~90
Syndiotactic Polystyrene	270	1,03	150-710 (Toluene, 30 °C)	~90
Atactic Polystyrene	190-230	-	30-700 (benzene, 25 °C) 10-1600 (Toluene, 25 °C)	~90

The test samples were taken in the form of granules. Using UR spectroscopic analysis, PS-525 polystyrene grades (OAO Nizhnekamskoilchemistry) were studied (Fig. 1).

Grade 525 - polystyrene for the manufacture of injection molded products and the production of coatings by joint extrusion. Designed for the malnufacture of medical and laboratory products, cups and jewelry boxes. The melt rheology of the present

polymer allows the coating of cups, plates and other disposable tableware. [3]

Using the Fourier method, IR spectrometry was used to identify the functional groups of isotactic polystyrene (Fig. 1). IR spectra were recorded and processed on a Perkin Elmer Spectrum Version 10.4.3 IR Fourier spectrometer with a resolution of 4 cm⁻¹ in the frequency range from 4000 to 400 cm⁻¹.

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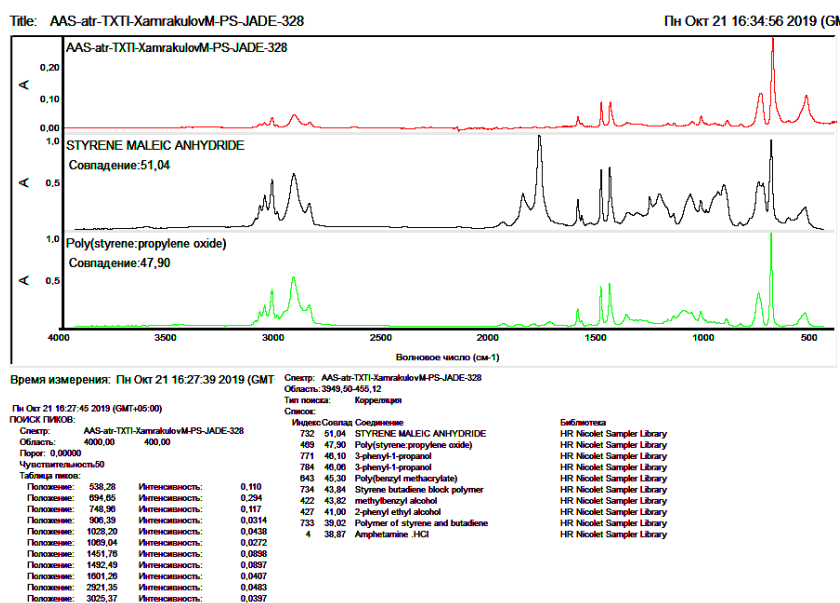
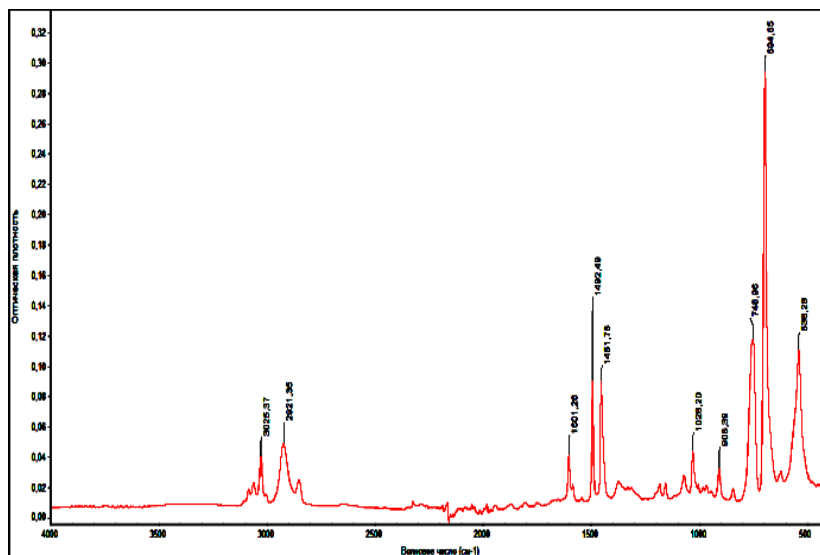


Fig. 1. IR spectrum of PS-525 polystyrene brand

3 RESULTS ACHIEVED

Table 3. Characteristic frequencies for some functional groups [4]

Frequency range (cm ⁻¹)	The assignment
~3400	OH stretching vibrations, deformation vibrations in vinyl alcohol
2920-2935	Asymmetric stretching vibrations of aliphatic CH ₂ groups
1580-1620	Mostly C=C stretching vibrations of aromatic rings
~1560, ~1410	C=O stretching symmetric and asymmetric vibrations in RCOO-
1450-1470	Deformation vibrations of aliphatic CH ₂ , CH ₃ groups
~1240	C=O stretching vibrations in CH ₃ C(O)=OR
830-940	Symmetric and asymmetric C-O-C stretching vibrations in aliphatic ethers

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The main features of the classification of carbochain polymers in primary forms are: type of polymer, specific gravity, structure, physical properties, composition, shape and size of granules, state of aggregation, hydroxyl number, purpose.

4 DISCUSSIONS

Since the polystyrene studied in the research is a different type of polystyrene, its detailing in accordance with the stereoisomers should be performed in 11-digit numbers and not in 10-digit numbers of the commodity of goods in foreign

economic activity of Republic of Uzbekistan. For this reason, it was proposed in the dissertation to clarify the commodity of goods in foreign economic activity codes for isotactic, syndiotactic, atactic and other types of polystyrene, namely a separate subsubposition of goods

As a result of studies using customs examination for polystyrene in primary forms, the following new code numbers for commodity nomenclature of foreign economic activity of the Republic of Uzbekistan are recommended. (table 4).

Table 4. Recommended code numbers for polystyrene in primary forms according to the Commodity Nomenclature of Foreign Economic Activity (in a new subheading)

Recommended product codes for the Commodity Nomenclature of Foreign Economic Activity	Name
39031100091	Isotactic PS
39031100092	Syndiotactic PS
39031100093	Atactic PS
39031100099	other types of polystyrene

Classification and coding systems for goods are necessary for the automated processing of product information in various fields of activity, for the study of consumer properties, the safety and quality of goods, the accounting and planning of goods turnover, the improvement of the standardization system for product certification and marketing research.

The safety of polystyrene, especially when it and its derivatives are used in the food industry as packaging material, is primarily assessed by the amount of residual monomer in the structure of polystyrene. This is due to the fact that polystyrene gets through a polymerization reaction of a monomer - styrene in a liquid state having a sufficiently high boiling point. Often, the polymerization reaction is

carried out at a temperature below its boiling point and, as a result, a certain amount of styrene monomer remains in the polystyrene structure. Often this amount of styrene is below the maximum allowable concentration (table 5.). However, given the high toxicity of styrene, it is necessary to strictly control its concentration in polystyrene products, depending on the areas of practical application and operating conditions. Polystyrene is often used as a disposable food package, such as disposable tableware and food packaging containers. At the same time, if packaged food products contain water, oils, fats and protein products with a limited shelf life, then the possibility of migration of styrene into food products into water of low rate of migration is excluded. [6]

Table 5. Sanitary rules and hygiene standards for packaging and closures [7]

Name of material	Controlled indicators	Allowable migration, mg/l	Maximum permissible concentration in water, mg/l	Hazard Class	Maximum permissible concentration in the air, mg/m ³	Hazard Class
Polystyrene plastics:						
block polystyrene shockproof	Styrene	0,010	-	2	0,002	2
	Alcohols					
	methyl	0,200	-	2	0,500	3
	butyl	0,500	-	2	0,100	3
	Formaldehyde	0,100	-	2	0,003	2
	Benzene	-	0,010	2	0,100	2
	Toluene	-	0,500	4	0,600	3
Ethylbenzene	-	0,010	4	0,020	3	

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Stabilizers are introduced into polymeric materials in very small amounts from 0.01 to 1%. The possibility of human contact with them, as well as food, cosmetics, water, lasts throughout the life of a person. Therefore, given the wide variability of individual sensitivity to chemical agents, the danger of a number of stabilizers penetrating through damaged skin, as well as the possibility of an allergic, carcinogenic, and mutagenic effect, their choice for synthetic materials should be carried out only after appropriate hygienic assessment. [8]

Stabilizers are added to polystyrene plastics in order to inhibit their aging under operating conditions. If polymeric materials are intended for technical purposes, then there is no reason to limit the list of chemicals used as stabilizers. [9]

Under the condition of heating foodstuffs in polystyrene packaging, the rate of migration of styrene into foodstuffs increases several times and in such conditions it is not permissible to use polystyrene packaging materials. [10]

Wine and vodka products are not allowed to be packaged in polystyrene containers, since due to the good solubility of styrene in alcohol-aqueous media, its migration rate increases hundreds of times.

5 CONCLUSIONS

In addition to the above, upon receipt of expanded polystyrene and its larger number of copolymers of various compositions, when using plasticizers in each case, taking into account possible applications, it is necessary to develop special methods for controlling the safety of polystyrene products.

Thus, materials in contact with foodstuffs must comply with the Hygienic standard "Maximum allowable quantities of chemicals in contact with foodstuffs" according to hygienic safety indicators. The values of hygienic standards indicated in them are the main evaluation criteria when conducting studies of materials.

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