INVESTIGATION OF FIRE-RESISTANT METAL COATINGS

[1]Iskandar Yaxshiqulov, [2]Eldor Nurkulov, [3]Abdulahat Djalilov.
[1]"Quality Pharm" Head of the laboratory of the company LLC
[2]PhD., associate professor. Karshi Institute of Engineering and Economics
[3]D.Sc., academician, Tashkent research institute of chemical technology
https://doi.org/10.5281/zenodo.8360477

Abstract. *In this article, the dependence of the coagulation process on the quality of the product in the production of rubber products from natural latex is studied through physical and mechanical properties. By modifying natural rubber, its physico-mechanical properties were increased, and the production of rubber products for high-quality medical gloves was studied.*
Keywords: *natural latex, medical gloves, rubber, coagulation, elasticity, strength, brand, emulsion.*

Introduction. Currently, emulsion polymerized rubbers are one of the main raw materials for industry, and the global demand for natural rubbers is increasing year by year. However, as in all industries, there are disadvantages in the rubber industry. Natural rubber (NR) from latex can be separated by chemical (using reagents) or physical (without reagents) methods. The process of coagulation or centrifugation of latex in the production of NR has a great impact on productivity when some of the non-rubber compounds, which are not environmentally dangerous, remain in the rubber, and the second part is mixed with the rubber in the waste.

In this proposed scientific study, the dependence of the coagulation process on the product quality in the production of rubber products based on natural latex was studied, and the physical-mechanical and economic efficiency of the rubber products in the production of medical gloves was increased.

The coagulation process is important in the production of "disposable natural latex sterile surgical and medical examination gloves" from medical equipment based on natural latex. Because the quality indicators of physical and mechanical properties of rubber of medical gloves directly depend on the concentration of natural latex and coagulant components, temperature of solutions, pH value, stability of solutions, conveyor speed and other parameters.

Methods and materials. Natural latex in the raw state is 60 % of the reserve mass, that is, rubber, and 1.6-1.7 % of ammonia is brought in the preserved state. 97 % of the dry mass of latex is isoprene rubber and about 3 % is in a natural mixture with various natural proteins and other organic additives. For the production process of medical gloves, filler additives are added to the prepared latex emulsion.

To prepare natural latex for production, it is diluted from 60 % to 28-30 % with filtered water in an alkaline environment. Sulfur, zinc oxide, caprolactam suspensions, plasticizer, emulsifier, coloring pigment and diffusant are added during preparation of emulsion. After that, the latex emulsion is heated to a temperature of 60 °C, allowed to cool down to its original state and mixed for a day. The ready-to-use latex emulsion is poured into a conveyor barrel and the process is carried out at a temperature of 28-30 °C. The emulsion in the barrel should always flow, be in a state of circulation. Otherwise, the surface becomes creamy and leads to the increase of unusable product.

Soluble salts of calcium, i.e. 4-5 % solutions of calcium chloride or 6-7 % of calcium nitrate are used as coagulants for the coagulation process. In addition, 2-3 % of calcium stearate emulsion and 0.01 % emulsifier are added. Calcium stearate acts as a lubricant to transfer the rubber from the hand mold. As the concentration of Ca^{+2} cation increases, the attractiveness of the latex emulsion also increases. As a result, the rubber thickens. On the contrary, the decrease in concentration causes the rubber to become thinner. Properties of rubber of medical gloves, such as durability, elasticity, shelf life, integrity, appearance, depend on the progress of the coagulation process. Therefore, according to the UzDst 3020:2015 standard, the thickness of the rubber should not be less than 0.10 mm.

The concentration of Ca^{+2} in the coagulant is proportional to the mass of the product, the thickness of the rubber, the speed of the polymerization process, the power required to move the medical gloves from the mold, the elasticity and strength of the rubber. As the concentration of Ca^{+2} cation increases, the rubber thickens and the product mass increases.

10-30 % starch suspension and 30 % KMS solutions were mixed in laboratory conditions to 30% latex emulsion prepared for production in technological processes, and rubber was obtained from the prepared emulsion. Sungra "CFBLS-I" rubber testing laboratory equipment was used to check the physical and mechanical properties of rubber.

Results and discussion. The rubber of medical caps made from a mixture of 30% of the usual latex should be milky, smooth, and have a strength of more than 12.5 N. Stability of the physical and mechanical properties of rubber depends on the course of technological processes, vulcanization, oven temperature, coagulation process, conveyor speed, concentrations of latex and other additives. Therefore, the process of manufacturing a medical mask has several complications. Table 1 shows the physical and mechanical properties of the rubber used for a medical mask, which is obtained by modifying and vulcanizing the LKRT brand modifier with natural rubber in different proportions.

1 table

Physico-mechanical properties of natural rubber (latex) used for medical gloves.

Phys features (S-2, AQL 1,5)	Modification NR+LKRT 90:10 %	Modification NR+LKRT 85:15 %	Анолог	
			(NR) 1-tur	(CK) 2-tur
The tensile strength, N, should not decrease from accelerated wear to pre-break	18.5	28.0	12.5	9.0
Accelerated wear to pre-breakage, %, should not be less	578	682	700	600
Tensile strength, N, when stretched to 300 % of the pre-accelerated wear should not increase	6.8	5.5	2.0	3.0
The tensile strength, N, should not decrease from accelerated wear to post-break	9,8	10,2	9.5	9.0
The elongation after accelerated wear to failure, %, should not be less	560	510	550	500

Note: the shelf life of the medical cups is tested by storing them in an oven at 70°C for 168 hours (1 week) (conditions equivalent to 3 years).

If we pay attention to the physico-mechanical properties presented in the table, we can see that the properties of the modified rubbers are similar to those of the analogues (NR and SK). , N, and the height of 2-2.5 was determined. This test results in economic efficiency of the rubber used for caps for the medical manufacturers of our country, based on the data analyzed based on the results of the partial localization of the raw materials of natural rubber.

As a result of our research, raw materials for obtaining medical gloves were obtained as a result of modification of TK (latex) polymers. The composition of modified TK mainly consists of TK (latex) and KRT brand modifier that we offer.

IR-spectrum was used to investigate the composition and structure of the modified TK obtained in this paper.

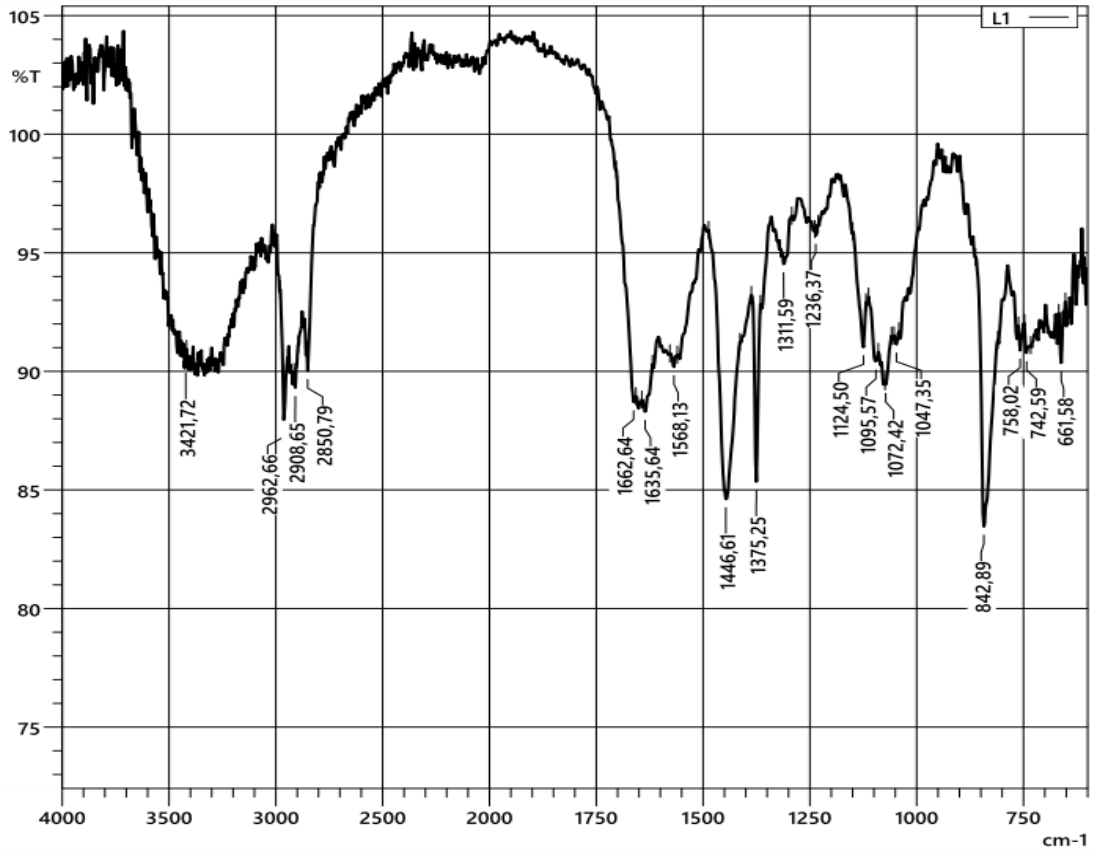

Figure 1. IR spectrum of natural rubber (latex)

Absorption line of IR spectroscopy of natural rubber (latex) spectrum of bonds –CH_3 groups in 1375.25 cm^{-1} area and 2962.66 cm^{-1} area, CH_2 group valence in 2850.79 cm^{-1} area, and 1662.64 cm^{-1} –C=C– valence group absorption there are lines (Fig. 1).

The next picture shows the IR-spectrum obtained after modification of natural rubber (latex) with KRT brand modifier.

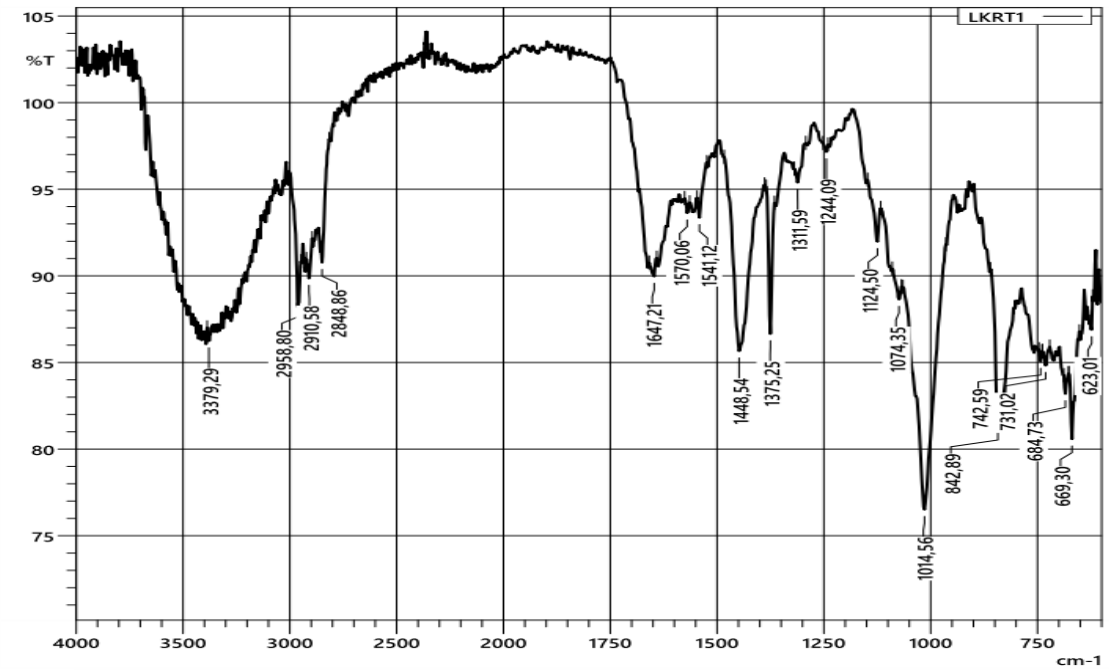

Figure 2. IR spectrum of modified natural rubber (latex)

IR spectroscopy absorption line spectrum of bonds –OH groups in 3379.29 cm^{-1} region, CH3 group in 1375.25-2958.80 cm^{-1} valence region, CH group in 2910.58 cm^{-1} valence region, CH_2 group in 2848.80 cm^{-1} valence region, –C=C There are absorption lines belonging to -C-O-C- groups in the -C-OH- group at 1124.50 cm^{-1} valence area, in the 1074.35 cm^{-1} area. We can see that there are absorption lines belonging to the valence group in the region of 623.01-842.89 cm^{-1}, where silicon (Si) and metal-containing bonds are present (Figure 2).

In conclusion, we can say that by modifying natural rubber (latex) in the production of rubber products, the quality of the product was increased and its physical and mechanical properties were studied. By modifying natural rubber, its physico-mechanical properties were increased, and the production of rubber products for high-quality medical gloves was studied.

REFERENCES

1. Fam Kim Dao. Coagulation of natural rubber and polyvinyl chloride latexes / Fam Kim Dao, A.N. Gaidadin, D.A. Gorkovenko [et al.] // Journal of Applied Chemistry. - 2018. - T. 91. - No. 2. - S. 273-278.
2. Fam Kim Dao. Coagulation of natural rubber latex poly-N, N'-diallyl-N, N'-dimethylammonium chloride / Kim Dao Pham, V. A. Navrotsky, A. N. Gaydadin, D. A. Gorkovenko // Izvestiya VolgGTU. Ser. Chemistry and technology of organoelement monomers and polymeric materials. - 2017. - No. 3 (198). - P. 70-74.
3. UzDSt 3020: 2015 "Disposable rubber latex sterile surgical gloves".
4. Sansatsadeekul J. Characterization of associated proteins and phospholipids in natural rubber latex / J. Sansatsadeekul, J. Sakdapipanich, P. Rojruthai // J. Biosci. Bioeng.– 2011.– Vol. 111. – P. 628–634.
5. Tangpakdee, J. Rubber formation by fresh bottom fraction of Hevea latex /J. Tangpakdee, Y. Tanaka, K. Ogura, [et. al.] // Phytochemistry. – 1997. – Vol. 45. – P. 269-274.

6. Liengprayoon, S. Lipid compositions of latex and sheet rubber from Hevea brasiliensis depend on clonal origin / S. Liengprayoon, J. Chaiyut, K. Sriroth [et al.] // European journal of lipid science and technology. – 2013. – Vol. 115. – P. 1021–1031.
7. Quazi, T. H. Shubhra. Long and short glass fibre reinforced natural rubber composites / Quazi T. H. Shubhra // Nat. Rubber Mater. – 2013. – Vol. 2. Compos. Nanocomposites. – P. 247-285.
8. Sakdapipanich, J.T. Natural rubber : biosynthesis, structure, properties and application / Sakdapipanich J.T., Rojruthai P. // RSC Polymer Chemistry. Series № 7. – 2014. – Vol. 1. – P. 28-52.
9. Le, H.H. The role of linked phospholipids in the rubber-filler interaction in carbon nanotube (CNT) filled natural rubber (NR) composites / H.H. Le, S. Abhijeet, S. Ilisch [et al.] // Polym.. – 2014. – № 55. – P. 4738-4747.