



ROSTEC STATE CORPORATION  
Kaliningrad Amber Combine  
Joint-Stock Company



# **CLASSIFIER**

## **of the Baltic amber of the Primorsky deposit**





*"The best way to explore something  
is to discover it yourself."*

*George Pólya,  
Hungarian, Swiss and American  
mathematician, popularizer of science*



**SET**  
**of scientific and practical**  
**researches and classification**  
**of Baltic amber**  
**of Primorsky deposit**  
**of Kaliningrad Amber Combine**

*The Power of the Sun - The Gift of the Earth - The Heritage of Russia*



*He who loves his work  
turns it into art*



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## INTRODUCTION

The purpose of the classifier of Baltic amber of Primorsky deposit is system classification of succinite by mining-geological, extraction, technological, natural, gemological, spectrometric, physical, mechanical, and geochemical properties taking with the consideration of application in jewelry production and other areas of deep processing of amber. Large-scale work on the classification and standardization of products progressively released by the Combine, is carried out in order to protect the rights of consumers. The next stage is the assignment of personal electronic codes to unique nuggets and jewelry made of amber.

The document also considers the potential of using Baltic amber in commercial, medical, tourist, practical, production and scientific activities.





**ЯНТАРНЫЙ КОМБИНАТ**

**2022**



*75 лет  
мы делаем мир красивее*



## ***HISTORICAL BACKGROUND***

Kaliningrad Amber Combine Joint Stock Company is the only enterprise in the Russian Federation and the largest enterprise in the world that conducts commercial open-pit extraction of Baltic amber at the Primorskoye deposit.

After the end of the Second World War by the decision of the Soviet Government (the resolution of the Council of Ministers of the USSR No. 2599 dated July 21, 1947), the enterprise was established to resume industrial extraction and processing of the Baltic amber.

Over the years of hard, painstaking and creative work, the company's employees have not only mastered and improved the technologies of industrial extraction of Baltic amber, but also recreated and significantly upgraded numerous techniques of artistic treatment of amber.

Raw amber and various finished amber products manufactured by the Combine are traditionally sought-after and enduringly popular both in the Russian and international markets.





President of the Russian Federation Vladimir Putin pays special attention to the progressive development of the amber industry of our country. The numerous changes taking place in recent years in the industry and directly at the enterprise are aimed at a constant increase in the volume of production of Baltic amber and in the volume of its domestic processing.

Since 2013, the Joint Stock Company has been a part of the ROSTEC State Corporation. Currently, the company not only successfully exercises extraction of raw amber, but also processes it at its own jewelry production facility which was significantly upgraded in 2021.

A variety of amber jewelry and numerous amber souvenirs are sold exclusively through the own chain of branded stores and official representative offices, one of which is located on Arbat Street in Moscow.

In 2022, Kaliningrad Amber Combine will celebrate its 75th anniversary. Many years have passed since the first amber was mined by the company's employees on the shores of the Baltic Sea. But life does not stand still, and with a glorious past and a worthy present, the enterprise and its employees are moving confidently into the future.

*"Amber is a piece of art of the plant kingdom."*

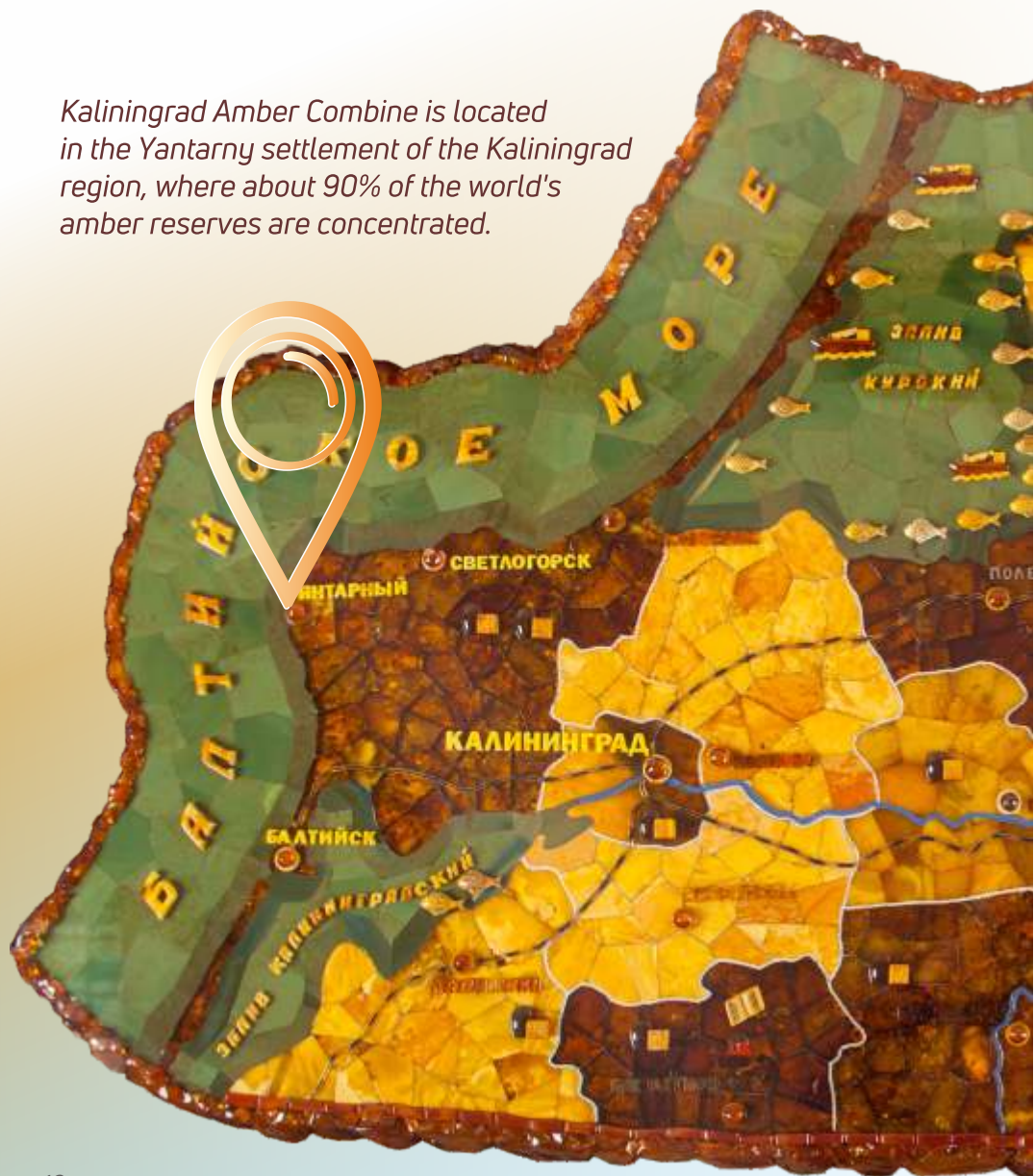
*Mikhail Lomonosov,  
the first prominent Russian natural scientist*

**Mining, geological  
and technological  
classification  
of Baltic amber  
of the Primorsky  
deposit**



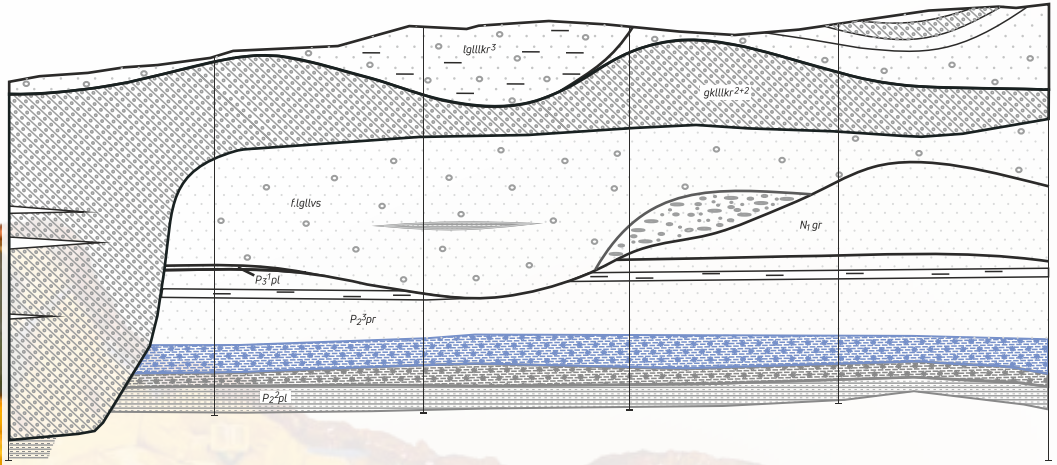
The age of the mined amber exceeds 40 million years. Amber is extracted by the open-pit method in the Primorsky open pit, the largest amber pit in the world. The Amber Combine produces an average of 500 tons of raw materials annually. Total reserves of Primorsky and Palmnikensky deposits are estimated at 116 thousand tons.

*Kaliningrad Amber Combine is located in the Yantarny settlement of the Kaliningrad region, where about 90% of the world's amber reserves are concentrated.*





# Typical geological section of the amber stratum



## Legend:

- |                                       |              |            |              |              |                   |  |
|---------------------------------------|--------------|------------|--------------|--------------|-------------------|--|
|                                       |              |            |              |              |                   |  |
| Fine, medium- and coarse-grained sand | Boulder clay | Sandy clay | "Wild earth" | "Blue Earth" | Argillaceous sand | Inclusion of gravel, pebbles, boulders |



# Geological factors of the Baltic amber deposit of the Primorsky deposit

License for subsoil use	Technical boundary (mining allotment), Ha	Amber formation	
KLG 02479 TE	Act No. 58k dated December 30, 2015, 1338.5 ha	Blue Earth (Wild Earth)	
Depth of occurrence along the bed top (m)	Bed width (m)	Reserves in category A+B+C <sub>1</sub>	
		Balance reserves (tons)	Off-balance reserves (tons)
44.3-65.0	0.5-17.9	56123.0	29540.6

## Paleogene stratigraphic scale

System	Section (era)	Stage (century)
Paleogene	Eocene	Priabonian
Series	Designations	Age, million years
Prussian	P <sub>2</sub> <sup>3</sup> P-f	40.4-44.0

## Geophysical parameters

Density, g/cm <sup>3</sup>	Mohs hardness	Fracture
1.05-1.09	2-2.5	Conchoidal
Melting point, °C	Softening point, °C	Line
250-450	100-150	Bold colourless



## Mining factors of the Primorsky deposit of Baltic amber

Method: open pit mining					
Development system					
Stripping: combined development system			Mining: hydraulic excavation method		
Equipment used					
Esh 11/70	Esh 10/70	Auto stripping	Esh 6/45	Hydromonitor GMN-250	Pump GrUT-2000/63
Mining and transportation equipment capacity (thousand m <sup>3</sup> per year) (tons per year)					
1396	810	1900	332.14	600	
Walking excavator ESH 6/45			Hydromonitor GMN-250		
					





Walking excavator  
Esh 11\70



Hydraulic excavator  
Kamatsu PS-300

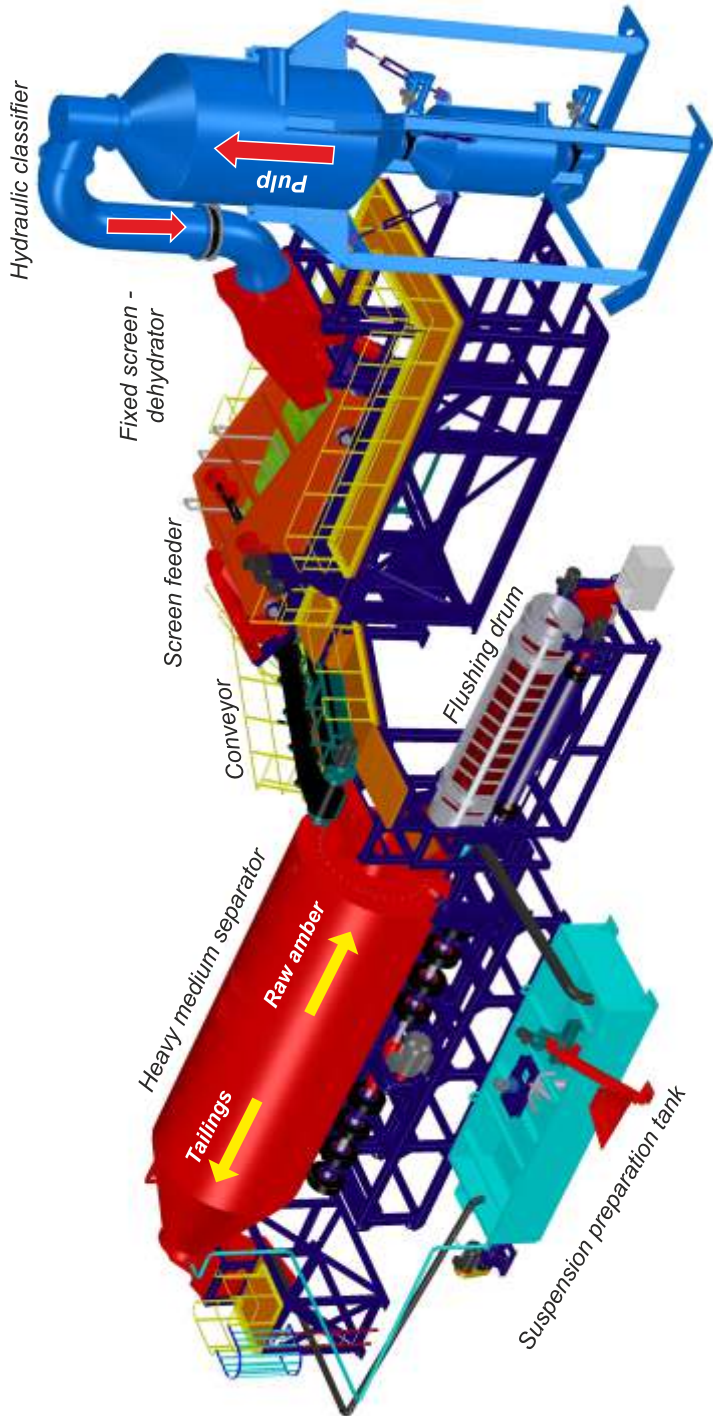


Mining dump trucks  
VOLVO A30D



Walking excavator  
Esh 10\70

**MOBILE AMBER EXTRACTION UNIT.**



*"Oh, if you, little fly, could talk!  
How different all our knowledge of the past world would have been.*

*Immanuel Kant  
German philosopher, Enlightenment thinker*

**Classification  
of Baltic amber  
of Primorsky deposit  
by natural,  
physico-mechanical,  
optical and geochemical  
properties**





# Natural properties of the Baltic amber of the Primorsky deposit

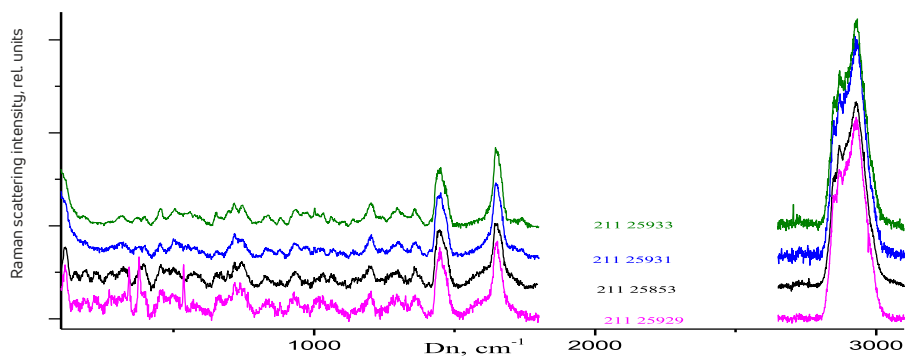
Physical, mechanical and geochemical properties of Baltic amber	
Relative hardness, Mohs scale	2 to 2.5
Density	1.05 to 1.09
Strength	Friable
Cleavage	No
Fracture	Conchoidal, viscous
Crystal system	No / amorphous
Morphology	Most often, it is found in the form of flattened and elongated precipitates that are not susceptible to genetic interpretation, there are precipitates in the form of teardrops, icicles, overlaps, pieces of amber with a cross-section of crescentic, lenticular and wedge-shaped, bearing more or less clear prints of wood
Geochemistry	Baltic amber is a high molecular weight compound of organic acids containing on average 79% carbon, 10.5% hydrogen, 10.5% oxygen. Its formula is $C_{10}H_{16}O_4$ . Amber contains 81 g of carbon, 7.3 g of hydrogen, 6.34 g of oxygen, a little sulfur, nitrogen and minerals. 24 chemical elements (Y, V, Mn, Cu, Ti, Zr, Al, Si, Mg, Ca, Fe, Nb, P, Pb, Zn, Cr, Ba, Co, Na, Sr, Si, Sn, Mo, Yb) were found in the Baltic amber in the form of impurities (from traces to 3%). Of these elements, unchanged amber contains Al, Si, Ti, Ca, Fe, Mg, Cu, and weathered amber contains only the first five elements

# Optical properties of the Baltic amber of the Primorsky deposit

## Optical properties of amber

Colour	Yellow, orange, red, brown, white, greenish, bluish, black. Mostly ranges from greenish-yellow, yellowish-orange, orange-red to red-brown
Transparency	Transparent, translucent, non-transparent.
Glance	Pitch
Fluorescence	Bluish-white to yellowish-green
Light refraction index	1.539-1.545
Optical nature	isotropic
Birefringence, dispersion, pleochroism	no

## Spectrogram







*"Amber passes through all ages and  
peoples to this day as a brilliant gem."*

*Alexander Fersman  
mineralogist, geochemist,  
academician of the Russian Academy of Sciences.*

## **Classification of the Baltic amber of the Primorsky deposit according to the standards of the Kaliningrad Amber Combine**



## Classification of unique Baltic amber

Pieces of amber of undefined shape, partially or completely covered with oxidized crust, weighing not less than 1000 g of all colors and shades typical of natural amber.



Unlimited quantities are allowed:

- natural inclusions of organic and inorganic origin
- through internal and surface cracks and cavities (porosity)
- volumetric surface layers of dirty, foamy, and layered amber

## Commercial classification of Baltic amber

Pieces of amber of undefined shape, partially or completely covered with oxidized crust, weighing not less than 1000 g of all colors and shades typical of natural amber.



### Requirements for sorted ornamental amber.

Parts of amber of indefinite shape, partially or completely covered with oxidized crust, weighing from 5 to 1000 g. Depending on the grade, surface and internal cracks, surface and internal inclusions of organic and inorganic origin, in different percentages are allowed.



### Requirements for fractional/screened amber.

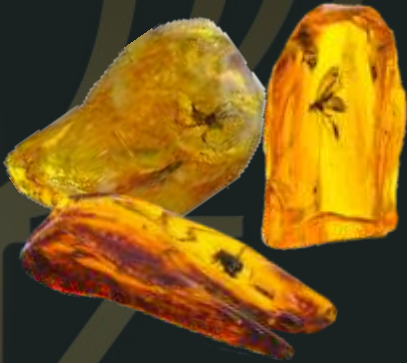
Pieces of amber of undefined shape, partially or completely covered with oxidized crust, with a width of pieces less than 23 mm

## Requirements for teardrop shaped amber



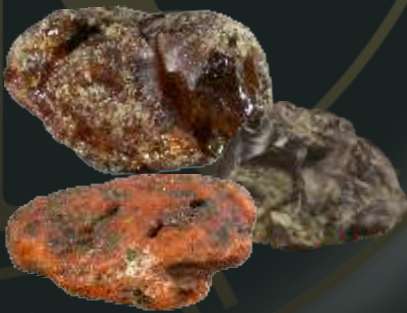
Pieces of spherical, peri-spherical, teardrop-shaped, oval, symmetrical fantasy shape, completely covered with oxidized crust

## Requirements for amber with inclusions



Pieces of amber of undefined shape, partially covered with oxidized crust, and containing completely or almost completely intact inclusions of flora and fauna

## Requirements for amber black varnish



Parts of undefined shape partially covered with oxidized crust. More than 50% of the piece volume is allowed: deep penetrating surface and internal cracks, deep and numerous cavities, voluminous surface layers of organic and inorganic origin and internal mud inclusions in unlimited quantities, internal saccharoid property of pieces, pieces of amber of loose, layered, foamy, and chalky structure



## Basic terms and types of Baltic amber of Primorsky deposit

### ***Natural amber***

Amber that has been machined without any change in its natural form

### ***Modified amber***

Amber that has only been heat-treated or pressurized. Amber changed its physical properties, including the degree of transparency and color

### ***Unique amber***

Pieces of amber weighing at least 1000 g of all colors and shades typical of natural amber

### ***Souvenir (landscape) amber***

Amber of matte and semi-matte color with shaped multi-tone stains, pieces of ivory amber

### ***Matte amber***

Amber, which does not allow light to pass due to the accumulation of air bubbles. It is of opaque uniform color ranging from honey to orange, different degrees of homogeneity

### ***Transparent amber***

Amber of any yellow tones, transparent, vitreous structure, transmitting light rays

<b><i>Sorted amber</i></b>	Amber, divided into types by certain weight, size and quality properties
<b><i>Unsorted amber</i></b>	Amber, cleaned from sandy-clay rock and other impurities, washed, dried, completely or partially covered with oxidized crust
<b><i>Black amber varnish</i></b>	Amber pieces containing unlimited organic and inorganic inclusions
<b><i>Substandard amber</i></b>	Amber sifting with a grain size of less than 4 mm produced as a result of screening
<b><i>Amber fraction</i></b>	Dimensional or weight properties of amber
<b><i>Grade</i></b>	Presence and quantitative content of mud inclusions, cracks, cavities
<b><i>Layered amber (amber inclusion)</i></b>	Amber consisting of several layers and containing mud inclusions, inclusions of flora and fauna. Inclusions are rare, with internal water droplets





*"We see amber as the next luxury item in a row..."*

*Gaius Plinius Sr.*

*Roman encyclopedic writer*

## **Classification of the Baltic amber of the Primorsky deposit according to standards of jewelry production**



## Baltic amber colour palette



Transparent



Lemon



Honey



Cognac



Dark cognac



Cherry



Green



Semi-matte



Matte



Landscape

## Baltic amber processing

Section	<ul style="list-style-type: none"> <li>- Manual sorting of amber by type (quality), volume, color and weight</li> <li>- Mechanical sorting of amber using a vibrating screen</li> </ul>
Stone cutting section	<p>In the bleaching area of the stone cutting section, amber is bleached (hardened) in autoclaves under pressure at a temperature of 200C.</p> <p>The semi-finished product is manufactured in several stages:</p> <ul style="list-style-type: none"> <li>- cutting amber using a sawing machine</li> <li>- machining using a grinding machines</li> <li>- manual polishing using a stone-cutting machine.</li> </ul> <p>The process of beads drilling is exercised in the drilling section. Quenching takes place in drying furnaces n compliance with the quenching scale. Parts made of amber are polished manually or mechanically in drums with wooden filler</p>
Ball calibration section	<p>The amber is cut using a sawing machine, and machined using a grinding machines to a spherical shape. The spherical beads are machined to manufacture a calibrated ball. Grinding is performed in small-sized grinding drums. Drilling is performed using a machine</p>
Amber machining section	<p>The amber machining section includes section of drum units and manual sorting.</p> <p>Mechanical treatment of fine-fraction amber is carried out in special units (drums) of own manufacture using abrasive wheels. Amber fr+4, fr-11.5, fr+11.5 is processed in three operations involving supplying flowing water to drums and intermediate heat treatment in autoclaves. Each operation corresponds to a different type of abrasive wheel used. The resulting product is screened on an own-produced vibration unit (using a sieve of the required diameter) and sorted manually into several types of semi-finished products in the form of beads</p>

# Process operation terms

## ***Autoclaving***

The process where cracks and air bubbles are sealed under the influence of temperature and pressure in the amber makes the amber compact, more transparent, and less fragile

## ***Tinting***

The process of re-autoclaving with the use of air, as a result of which the surface of amber acquires a darker shade. After removing the tint from one of the part planes, a green shade of amber is obtained

## ***Закалка***

Thermal effect on autoclaved transparent amber which acquires the following gradation of shades depending on the duration of the heat treatment: lemon (light yellow); light cognac (light brown); cognac (brown, tea); dark cognac (dark brown); cherry (dark maroon); green (black backlight)

## ***Matting***

The process of saturating amber with water under certain temperature and pressure, where the amber color turns opaque uniform from cloudy yellow to white, with varying degrees of homogeneity

## ***Coloring***

The process of coloring pressed amber with dyes

## ***Pressure molding***

The process in which ground amber is heated and pressed in sealed moulds, followed by cooling

## ***Enameling***

Application of an enamel coating on an amber semi-finished product (insert) to obtain an appropriate shade

## ***Gem cutting***

Processing of amber in order to give it a given shape with faces

## ***Ageing***

Giving the surface of natural matte amber a richer yellow color

# CALIBRATED BALLS



**Calibrated ball**

natural



**Calibrated ball**

lamina



**Calibrated ball**

lamina



**Calibrated ball**

black varnish



**Calibrated ball**

black varnish



**Calibrated ball**

transparent



**Calibrated ball**

transparent



**Calibrated ball**

light cognac



**Calibrated ball**

cognac



**Calibrated ball**

dark cognac



**Calibrated ball**

cherry



**Calibrated ball**

lemon



**Calibrated ball**

matte



**Calibrated ball**

landscape



**Calibrated ball**

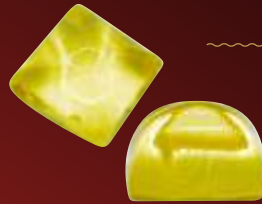
natural



# CABACHONS



**Rounded hardened cabochon**  
cherry



**Round square**  
landscape



**Rounded hardened cabochon**  
green



**Round oval**  
landscape



**Rounded hardened cabochon**  
cognac



**Round marquise**  
landscape



**Rounded hardened cabochon**  
lemon



**Rounded hardened cabochon**  
dark cognac



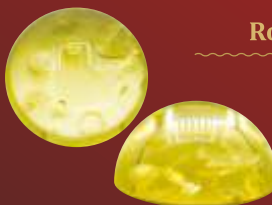
**Rounded hardened cabochon**  
light cognac



**Round cabochon**  
natural



**Round cabochon**  
matte



**Round cabochon**  
bleached

# CUBES



Hardened cube  
lemon



Hardened cube  
light cognac



Hardened cube  
cognac



Hardened cube  
dark cognac



Hardened cube  
cherry



Cube  
matte



Cube  
lemon



Cube  
black varnish



Hardened cube  
lemon



Hardened cube  
transparent

# BATTERED BALLS



**Battered ball**  
matte

~~~~~ grade 1



~~~~~ grade 2



**Battered ball**  
black varnish

~~~~~ grade 1



~~~~~ grade 2



**Battered ball**  
transparent

~~~~~ grade 1



~~~~~ grade 2



**Battered ball**  
landscape

~~~~~ grade 1



~~~~~ grade 2



**Battered ball lamina**  
honey

~~~~~ grade 1



~~~~~ grade 2



**Battered ball**  
light cognac

~~~~~ grade 1



~~~~~ grade 2

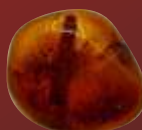


**Battered ball**  
dark cognac

~~~~~ grade 1



~~~~~ grade 2



**Battered ball**  
cognac

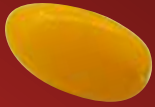
~~~~~



**Battered ball**  
lemon

~~~~~

# OLIVES



Olive  
matte



Olive  
matte



Olive  
bleached



Olive  
lemon



Olive  
light cognac



Olive  
cognac



Olive  
dark cognac



Olive  
natural

# PEBBLE



Pebble  
matte



Thin rounded pebble  
lemon



Thin rounded pebble  
bleached



Thin extended pebble  
lemon



Thin extended pebble  
lemon



Thin extended pebble  
light cognac



Thin rounded pebble  
cognac



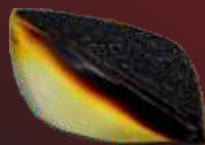
Thin rounded pebble  
matte

Thin rounded pebble  
light cognac





# ARTISTIC INSERTS



# FINISHED PRODUCTS



more than

# 200

jewelry models



more than

# 100

items of souvenirs



# PICTURES, SOUVENIRS







**Unique nuggets**  
Amber Chamber Exhibition Hall  
Yantarny



## Unique nuggets

Amber Gallery Exhibition Hall

Moscow, Arbat



## Unique amber teardrops

Amber Gallery Exhibition Hall

Moscow, Arbat





## Scope of industrial application of Baltic amber of Primorsky deposit

### Industrial application of Baltic amber.

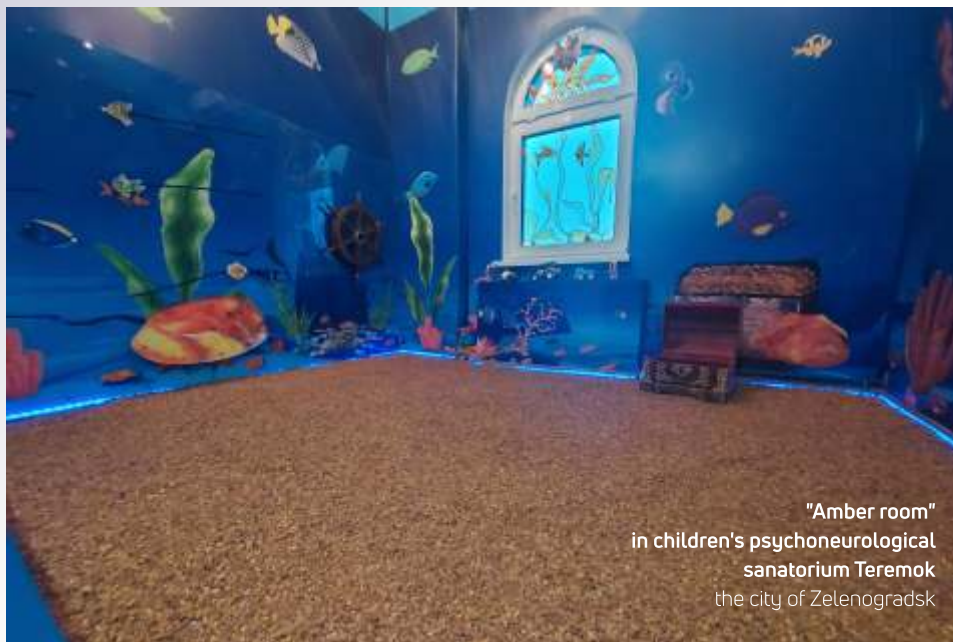
Similar to mica and porcelain, amber is a dielectric, so it does not conduct electric current. Therefore, about 10% of pressed amber is used in industry as a material for the production of insulators in electrical and radio engineering, and in instrument making. The chemical inertness of amber makes it possible to use it for the manufacture of medical instruments and durable ware for storing active acids, devices and tools for transfusing blood, as well as vessels for blood preservation.

Amber rosin is used to make all kinds of varnishes and enamels. Varnishes YaK-1 and YaK-2 are of particular value. They are particularly resistant to environmental impact and have a strong shine. The varnish is used to cover bottoms of ships, the inner surface of tin cans, floors, and furniture.

musical instruments, wool. Furniture covered with amber varnish retains shine and freshness of polishing for a long time. Famous violin masters of the 16th-18th centuries applied amber varnish to their works. Varnishes are also used in the production of printing inks and as electrical insulation of wires.

Amber oil is a mixture of different acids. It is dark brown with a yellowish tinge. The odour is strong and unpleasant. Lighter than water. It is used for the production of amber waterproof oils. Organic paint solvents for the rubber and porcelain industries can be produced from amber oil with the chemical processing. Oxidized amber oil is the primary product for producing strong caprone threads. Some time ago, amber oil was used to protect wood from decay (it was used for impregnating railway sleepers) and as a flotation reagent in the concentration of various ores and coal.

The current range of application of amber acid is very wide, and each new study in this field adds invaluable knowledge to the scientists' collection. For example, in medicine, it stimulates the nervous system, and is used as an anti-inflammatory and antitoxic agent. The ability of amber to prevent hemolysis (the process of destruction of red blood cells) is especially noted by modern physicians. The use of fine mineral particles for cosmetic purposes makes it possible to significantly increase the effects of procedures.



"Amber room"  
in children's psychoneurological  
sanatorium Teremok  
the city of Zelenogradsk







## CONCLUSION

Currently, the classification established by the Kaliningrad Amber Combine is of the greatest practical importance, since more than 70% of the amber sold on the world market comes from the Kaliningrad region.

The classifier of the Baltic amber of the Primorsky deposit is not limited to the narrow bounds of application tasks for the establishment of groups and grades of mineral for subsequent determination of their market value. It covers various aspects of present knowledge about the Baltic precious stone and the Primorsky amber deposit in the Kaliningrad region of the Russian Federation: geological description of the deposit, parameters of technological processes of open mining at the Primorsky pit, analysis of natural, physical and chemical, optical and geochemical properties, and it also includes a classification of raw materials complying with the standards of the Kaliningrad Amber Combine for jewelry production and industrial application.

The classifier is a brief popular scientific presentation of a comprehensive study of Baltic amber, where a large group of specialists from the Amber Plant and researchers from KSTU and Nesmeyanov Institute of Organoelement Compounds of RAS took part. With a large number of infographics and illustrations, it tells in an understandable manner about all stages of the production operations of Kaliningrad Amber Combine starting from the extraction to the manufacture of finished products. The classification of standards of jewelry production adopted at the Combine (shape, color and other properties of cabochons, balls, cubes and other amber inserts) for the first time presented to a wide audience is of a special value. In general, the work will not only contribute to the popularization of knowledge about Baltic amber and tell about the achievements of the Amber Combine, but will also help to improve the technological processes at the Combine and improve products quality.

Leading Researcher  
of the Kaliningrad Regional Museum of Amber

Z. V. Kostyashova

## List of technical literature used for the classifier of Baltic amber of Primorsky deposit

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- S. S. Savkevich Amber. L.: Nedra, 1970.
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- B. Yu. Vorotnikov A. G. Bulychev O. I. Karsten T. B. Ezhevskaya Studying amber varieties using FT-801 Fourier transform infrared spectrometer by the method of FTIR spectroscopy. Laboratory and Production, scientific and technical magazine No.2/2019(6) - p.104-109





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Classifier of Baltic amber of Primorsky deposit developed by the specialists of Kaliningrad Amber Combine JSC and the researchers of KSTU and RAS, covers all processes of the entire production cycle, starting from the geological exploration and extraction of raw amber to the release of finished products. The document is intended to improve products quality and to ensure that all concerned persons and the general public have access to information about the high standards and requirements followed by the enterprise.

