

10500 - 10580 Lapis Lazuli, natural ultramarine

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| Chemical composition : | (Na, Ca) ₈ [(SO ₄ ,S,Cl) ₂ (AlSiO ₄) ₆] Sodium calcium aluminum silicate |
| Color index: | Ultramarine Blue Pigment 29, C.I. 77007 |
| CAS Number: | 57455-37-5 |

Genuine ultramarine blue pigment is made from the semi-precious stone, lapis lazuli, which is a mixture of the blue mineral lazurite, with calcspar and iron pyrites.

Lapis lazuli was brought to Europe in medieval times from mines located in Badakshan, which is now a province of north-east Afghanistan. The famous Badakshan mines lie in a most inaccessible region at the headwaters of the Oxus near Firgamu, and appear to have been worked very early and possibly were the source of the lapis lazuli used in Mesopotamia and in classical times. The mines were visited by Marco Polo in 1271 in connection with the journey he made, and he stated that the mineral was used for the extraction of a blue pigment. The mineral was probably imported into Europe mainly by way of Venice, the principal port for trade with the East. In northern Europe, azurite is the more commonly encountered blue pigment in easel paintings while ultramarine was exploited on a more lavish scale in Italy, especially in Venetian paintings.

Unless the mineral is of very high quality, simple grinding, washing and sieving is carried out for its preparation as a pigment. This leads to a pale grayish blue powder. In Byzantine manuscripts dating from the sixth to twelfth century contained ultramarine of this description. It contained a high proportion of colorless material and may have been prepared in this simple way.

Soon after 1200, as is revealed in thirteenth-century references, a new and improved method of extraction came into use. There are numerous instructions for the preparation of ultramarine found in fourteenth century literature, one of the most detailed being by Cennino Cennini in the beginning of the fifteenth century.

The principle of the method was that the ground mineral was incorporated into a mixture of melted wax, resins and oils. The molten mass was wrapped around a cloth and kneaded under a dilute solution of lye (a solution of potassium carbonate prepared by extracting wood ashes with water). Our best quality lapis lazuli (Fra Angelico blue) is still made by this lavish procedure. Blue particles of lazurite are washed out by this process and collect by settling at the bottom of the vessel. Most of the colorless crystalline material and other impurities remain behind in the doughy mass. It is usually carried out in at least three separate extractions, offering several grades of diminishing quality. The largest and deepest-colored particles emerge in the first extraction

While the last extraction contains a high proportion of colorless material with only a few small blue particles. This product is known as ultramarine ash. It has a high degree of transparency and was valued as a blue glazing pigment.

Lapis lazuli has good tinting strength and hiding power, despite the low refractive index of the pigment. However, it can be regarded as a translucent glazing pigment when used in oil. The distinctive pure bright blue color of the dry pigment is retained when bound in an aqueous media such as egg tempera. In oil it is used to best effect either mixed with white to produce a brilliant opaque blue, or else as a thin translucent glaze over a lighter underpaint.

In the past, natural ultramarine is mainly seen unmixed with pigments other than white, but its slightly violet-blue hue made it more of value for producing purple colors by mixing it with crimson-colored lake pigments such as madder. However, more often a purple color was achieved by superimposing layers of ultramarine over an opaque body of pink or crimson body color or by a glaze of crimson over an opaque underpaint of ultramarine and white.

Natural ultramarine has a very high stability to light. Although it is a sulfur-containing compound, it was regularly mixed with lead white with no reported occurrence of blackening of the lead white pigment to lead sulfide.

The blue particles of natural ultramarine are of irregular size and angular in shape. The particles are rarely crystalline, but often flattish with a conchoidal fracture. There are usually varying amounts of crystalline mineral impurities, mainly colorless, mixed with the blue particles. The particles are of a translucent pure blue by transmitted light, and deep opaque blue by reflected light.

Excerpts from:

Artist's Pigments Vol.2 Ashok Roy (editor) and
Painting Materials Rutherford J. Gettens and George L. Stout

Lapis Lazuli, Lasurite

$(\text{Na}, \text{Ca})_8[(\text{SO}_4, \text{S}, \text{Cl})_2(\text{AlSiO}_4)_6]$

Density: 2.4 (Raw material: approx. 2.9 g/cm³)
Particle shape: sharp-edged chips, relatively coarse
Refraction index: n = 1.5

Relative X-Ray Absorption:

Color: From pale blue to deep blue, rarely violet blue.

Colorimetry:

Possible coloring techniques: Fresco, oil, tempera, watercolor, encaustic.

Stability towards coloring media: Good (except: possible decoloration by free-oil acids from the coloring oils)

Compatibility with other pigments: Ultramarine should not be mixed with colors containing copper or lead.

Covering power: Between average and good; Lapis lazuli is rather a scumbling pigment.

Solubility: Insoluble in water and organic solvents; reacts with acids, molten salt, organic halogenides, etc. (totally insensitive towards alkalis; important for the processing).

Artistic application: Lapis lazuli is a scumbling pigment (refraction index \approx linseed oil; n = 1.50 -1.54), miscible with white and colored pigments in any proportions.

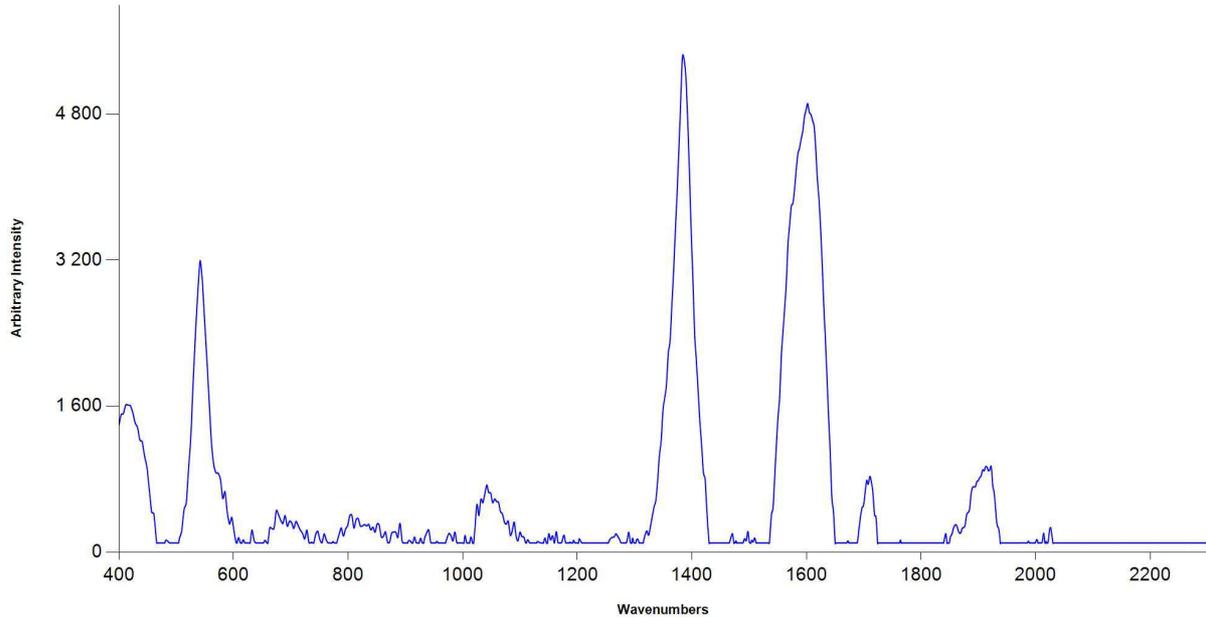
Toxicity: Non-toxic product.

Stability:

Fastness to lime: good
Lightfastness: very good
Temperature stability: with nitrogen up to 950°C, at air decomposition above 150°C.
Air humidity: not completely fast to water.

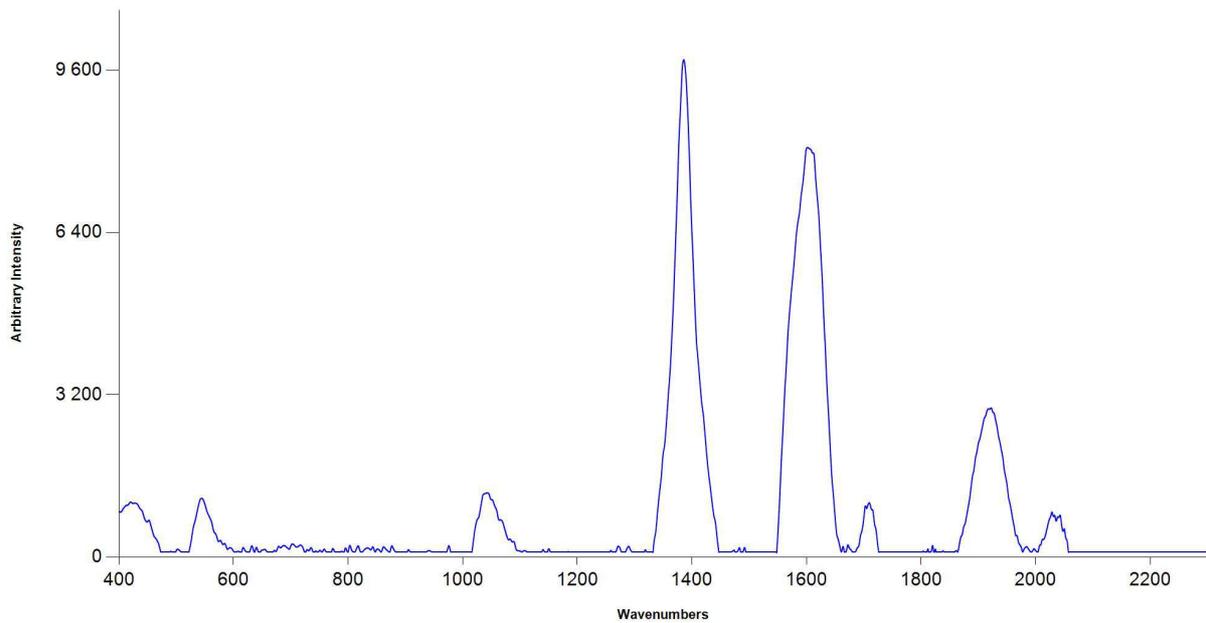
Below layers of oil, it is possible that the pigment particles absorb humidity, swell and thereby affect the adhesive force of the binding agent. Acid gases (e.g. in industrial cities or areas) can cause sulfuric acids which can decolor the pigment. This phenomenon is also called the "Ultramarine disease".

Raman spectrum of 10550:
(Source: MR PHSG, 2017)



— Sample Spectrum

Raman spectrum of 10562:
(Source: MR PHSG, 2017)



— Sample Spectrum