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GEM TESTING LABORATORY

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New type of glasses with 'crystalline inclusions'

Glasses have been the most common and widely used gemstone imitation. It has the capability of imitating almost every gem material ranging from transparent to opaque and in all possible colours. Emeralds, rubies, sapphires, diamonds, tourmalines, aquamarine, etc are only the few to name which are commonly imitated by glasses. However, widely available, identification of the glasses is not at all challenging as compared to few synthetic counterparts. Most of the glasses can be identified by the presence of classic inclusions like gas bubbles (of various shapes), swirl marks, devitrification effects or crystallites. In the absence of these inclusions, identification can be made using optical and physical properties; glass is isotropic while most of the gemstones it imitates are anisotropic. Further refractive index and specific gravity aids in the identification.

However, in the mid of June this year, we received for identification few translucent blue and green specimens which turned out to be glasses (Figure 1). Visually, they imitated blue chalcedony and / or turquoise. Glass imitation chalcedonies or turquoise have been known in the past as well, but these specimens were quite unusual because of their inclusion patterns; these consisted of transparent elongated 'crystalline inclusions'.

Figure 1

The depositor was concerned about the identification of these specimens as glasses because these are being sold as blue chalcedonies in the market. On discussion, it was found that these glasses are available in the market in large quantities and mainly comes from Taiwan. Mr. Rajesh Dhamani of National Facets was kind enough to share this piece of information and donating few pieces of rough and cut samples of these glasses for study purpose (Figure 2). Following is the description of basic gemmological properties of these unusual glasses.

Visual Appearance: The studied rough and cut samples of these glasses were in the colour range of sky blue, grayish blue, greenish blue, greenish yellow and even parti-coloured blue and green (Figure 2.a & b). Most of the samples were translucent to opaque; however, few samples appeared semi transparent. The rough samples displayed a granular surface, similar to many natural gem materials like chalcedony. Hence, when observed in its rough state, even the experienced eyes can misjudge these glasses as some natural material.

Figure 2a

Figure 2b

The samples with low degree of transparency, also displayed weak sheen effect on turning them in various directions; this effect was however observed only in certain areas.

When illuminated with a fibre optic light, some of these displayed a whitish cloudy and patchy effect as seen in many natural gem materials of massive nature.

Figure 3

Properties: All standard gemmological tests were performed on all samples. Following are the results:

Refractive Index (Spot): 1.490 to 1.520 (No Birefringence blink)

Specific Gravity: 2.492 to 2.524

Ultraviolet Fluorescence: Strong greenish yellow and blue under shortwave in blue samples; green or yellow green samples displayed a weak greenish glow. All samples were either inert or exhibited a weaker reaction under long wave.

Chelsea Filter: None

Visible spectrum: Deep blue sample displayed absorptions at the red corner and in the yellow region at around 580 nm. The yellow green sample also displayed similar patterns but was weaker while no absorptions were seen in other light blue samples.

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Spectroscopic Features

FTIR: Infra red spectra were collected for all samples, but no distinct features were observed for opaque to semi translucent samples. A distinct and conclusive pattern of graph was obtained in the thinner sections or samples which allowed the IR rays to easily transmit through them.

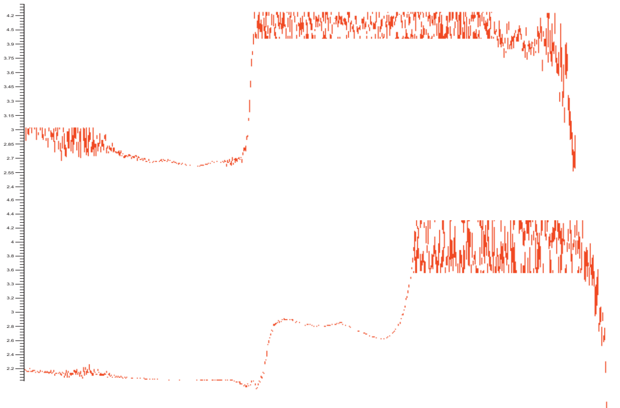

Figure 4: FTIR Spectra of glasses

EDXRF: Qualitative elemental analyses revealed the presence of Si as expected for a glass. In addition, Ca, Fe and Cu were detected in blue samples while Cu was missing from the yellowish green. Further, the intensity of Cu peak decreased while that of Fe peak increased with the decreasing blue colour and increasing yellow / green colour.

Inclusions: The most interesting and unusual features seen in these glasses were the inclusion features. These glasses contained numerous elongated transparent crystalline inclusions. Some of these were scattered while some were densely packed and gave an impression of devitrification effect commonly observed in glasses. Following are few inclusions which were observed in these glasses.

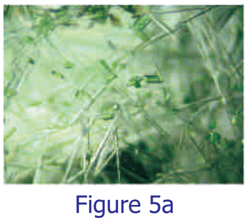

Figure 5a

Figure 5.a: These scattered crystalline inclusions may easily misidentify these glasses as a natural gem. Also note the green colour of tabular crystals.

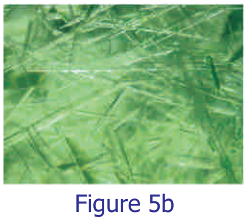

Figure 5b

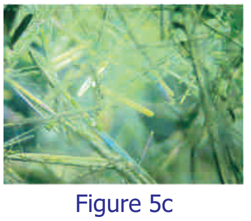

Figure 5c

Figure 5.b & c: These numerous elongated crystals were quite similar to the actinolite / tremolite needles found in emeralds of Russian and /or Sandawana origin. When observed under crossed-polar, these elongated inclusions appeared birefringent giving interference colours. This proves that these crystalline inclusions are anisotropic in nature.

Figure 5d

Figure 5.d: In addition to the scattered elongated crystals, some specimens also displayed densely packed fine needle like inclusions.

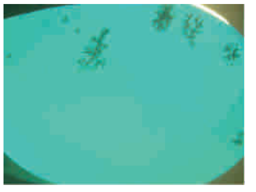

Figure 5e

Figure 5.e: Few samples also displayed dendritic inclusions as seen in opals and chalcedonies. These were rows of surface cavities trapped with some impurities.

Hanni et al. (2001) have identified these reported elongated transparent crystals in the glasses as Wollastonite (see, A glass imitation of blue chalcedony, The Journal of Gemmology, Vol. 27, No. 5, pp 275- 285).

A cautionary note......

Recently, we have also seen few specimens of natural quartz with similar crystalline inclusions (Figure 6). When encountered for the first time, correct identification was a real challenge because of the inclusion pattern.

The gemmological properties were consistent with those of quartz but the inclusion pattern foxed us along with the chalky fluorescence under SWUV.

Figure 6

This quartz specimen was full of blue coloured elongated crystals similar to those seen in the reported glasses (Figure 7).

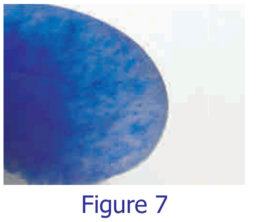

Figure 7

Magnification revealed that these quartzes are colourless/ white in colour but the blue colour visible is due to the presence of numerous blue coloured elongated crystalline inclusions; the exact nature of crystalline inclusions could not be identified.

The gemological properties were consistent with those for quartz but quite close to these glasses. In addition, the presence of similar inclusions, therefore a careful spectroscopic analysis (using FTIR and EDXRF) was performed. The results thus obtained conclusively differentiated these quartzes from the glasses reported. Many types of quartzes have FTIR spectrum similar to the type I spectra of the glasses (see, figure 4. top); this mainly is affected by the transparency of the material. Therefore, thin sections were obtained to get the FTIR data which was very much distinct from the glass (see, figure 4.bottom) and was typically associated with the quartzites or aventurine type quartz.

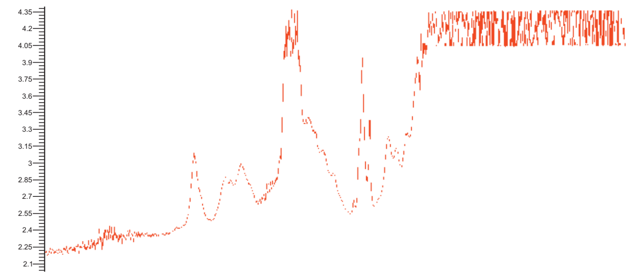

Figure 8: FTIR spectra of blue quartz containing numerous blue crystalline inclusions

EDXRF analysis revealed the presence of K, Ti, Fe, Sr and Zr as minor elements in addition to Si which was expected for Quartz. All these trace elements may correspond to the inclusions present.

Therefore one has to be careful if such glasses with numerous crystalline inclusions are encountered. These stones may be quartz! However, on the basis of gemmological properties, inclusion pattern, and spectroscopic analysis, the distinction between these glasses and quartz can be done.

GTL completes 37 years of existence……

On 12th of August 2009, the Gem Testing Laboratory has completed 37 years of its existence and services to the gem and jewellery trade. As most of the readers are aware that GTL was established in the year 1972 on this very date and since then it is involved in certification of gemstones providing some degree of clarity in the business dealings. Since the year 1992, GTL also started gemmological courses in order to provide the industry with a better and educated manpower. Till date, more than 1200 candidates have been benefitted from various courses being conducted at GTL. There has been gradual up gradation in the quality of services being offered since its inception and we assure to carry the same in the future as well for the benefit of the gem and jewellery trade.

Unusual Serpentine Cat's Eye

Recently, we had the opportunity to examine an unusual opaque bluish green cabochon weighing 36.63 ct that had a broad but distinct chatoyant band (figure 9). The colour, greasy-to-dull luster, and low heft suggested it was serpentine.

Figure 9

Spot RI was measured at approximately 1.57 with no distinct birefringence blink; hydrostatic SG—2.60; weak yellow fluorescence was observed under long-wave UV; and weak bands in the green (~490 nm) and blue (~460 nm) regions were seen with the desk-model spectroscope. In addition, the lustre indicated low hardness, which was confirmed by scratching with a fluorite crystal on an inconspicuous part of the sample. These properties are consistent with those reported for serpentine.

Serpentine is usually used as an imitation of jadeite and nephrite because of its similar aggregate structure and colour appearance. It is usually seen in variable hues of blue, green, and yellow, and comprises species such as antigorite, chrysotile, and lizardite, and varieties such as bowenite, williamsite, and ricolite. Chatoyant serpentine, however, is quite rare. "Satelite," a fibrous variety exhibiting chatoyancy, has been reported from Maryland and California in the U.S and from Sichuan Province in China.

When the cabochon was examined with a microscope, thin parallel planes were visible. These appeared to be composed of fine films oriented perpendicular to the chatoyant band (figure 10.a), and were thus responsible for the cat's-eye effect. In addition, a few scattered brown dendritic crystals and white cloudy patches were present (figure 10.b)

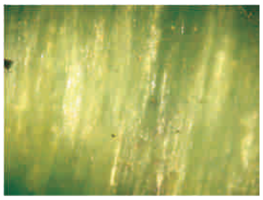

Figure 10a

Figure 10b

Because serpentine is a hydrous material, the FTIR spectrum in the 6000–400 cm-1 range exhibited complete absorption from 4500 to 400 cm-1 and two bands around 5000 and 4700 cm-1. EDXRF analyses revealed the presence of Mg, Si, Cr, Fe, and Ni, as expected to be detected in serpentine

Black Diamonds – some new challenges!

In the recent past, there were increased numbers of black diamonds received for identification. This clearly reflects the increasing trend of black diamond jewellery. However, we have received not only black diamonds but other black materials as well which closely resembles to diamonds. The two most common materials received as simulants include Black Moissanites and Black Treated Spinel.


Treated Diamond


Synthetic Moissanite


Treated Spinel

Black Moissanite: The growth technique for black moissanite is slightly different from the colourless ones. In this case, the components Si and C are dissolved in the molten iron; hence, iron is trapped in the growing crystal and produces black colour. Identification too becomes difficult with only a 10x lens which was possible for the colourless or light coloured varieties. Because of the opacity, no doubling or inclusions and / or fire is observed. However, when a strong light is used along with magnification using a 10x lens, a diamond tend to display some fractures with concentrations of black appearing particles; often white to gray areas are observed in between fractures. Black Moissanite will not display such features but one has to be careful regarding the coarse polish, since this will give the impression of fine particles. Moissanite also displays an adamantine lustre as that of a diamond; due to its high hardness (9.5) it will also scratch corundum.

These black moissanites can conclusively be separated from diamond on the basis of specific gravity. The SG value for moissanite is around 3.23 but has been recorded as low as 3.15; these values are much lower than that of diamond at 3.52. Elemental analysis using EDXRF gives further confirmation. The analysis revealed the presence of Si and Fe; the former one cannot be found in a diamond.

Black Treated Spinel: In the last two years, various specimens of black spinel have been identified at GTL; the stones encountered can be divided into two types on the basis of their lustre. Few spinels displayed a typical bright vitreous lustre while few sub-metallic to adamantine, similar to black diamonds. The stones with the metallic lustre appeared to be treated in some or the other way.

The exact nature of the treatment however could not be detected, but they appeared to be coated. This can be speculated on the basis of repolishing done on specimens with metallic appearance. On re-polishing the lustre of those spinels reduced considerably possibly because of the removal of the coated material. Standard gemological testing and elemental analyses did not revealed anything unusual in order to conclude coating. Although in one such spinel, high concentration of Ti was detected as compared to the others.

GAAJ-ZENHOKYO Laboratory in their newsletter also revealed the coating on black spinels. As per the newsletter, two types of coating treatment exist, one giving a metallic lustre to appear as black diamond and the other with metallic blue lustre. Analysis revealed that a stone with the former type of treatment was coated with Sn (tin) and a stone with the latter type was coated with Ti (titanium).

When the surface layer near facet edges was observed under the microscope with a strong oblique illumination, abrasions and chippings of the coating layer was seen. This coating layer is presumably very thin although stable under normal wear and cleaning. However, this coating layer may come off when scratched by a pin or a blade.

Other than the visual appearance, no feature was present in the samples we studied which could prove these spinels as treated.

These two materials- black moissanite and black spinel are widely used as diamond simulants and are mixed in larger lots of black diamonds, especially when the stone sizes are small.

Created and Edited by : Gagan Choudhary, *Asst. Director (Tech. & Training)*

Contact for further details : Meenu Brijesh Vyas, *Asst. Director (Tech. & Training)*

Radhamani Amma, *Asst. (Coordination & Info.)*

Priti Singh, *Gemmologist*

GEM TESTING LABORATORY
Rajasthan Chamber Bhawan
M.I. Road, Jaipur, India
Phone : 91-141-2568221, 2573565
Fax : 91-141-2567921
Email : gtl@gjepcindia.com
Website : www.gtljaipur.info