THE GEM & JEWELLERY EXPORT PROMOTION COUNCIL

GEM TESTING LABORATORY

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Coloured Impregnation Or Dyeing?

One of the most controversial subject to discuss with respect to emeralds or rubies or sapphires or... is the identification and / or certification of colour enhanced stones.

In the last issue of LIC a discussion was made on fracture filled rubies with high lead content glass. This discussion may be considered as an extension to the same.

When we talk about colour-enhanced stones, we refer to coloured impregnation, dyeing, heating with/ without additives, HPHT and irradiation. Here the controversy lies in considering a colour impregnated stone as dyed or colour enhanced.

Coloured impregnation refers to the filling up of surface reaching cracks with a coloured material like 'jhoban' oils, resins, wax, plastics, polymers, etc., so as to enhance the colour of a pale coloured material. This treatment is commonly performed on light coloured emeralds, rubies and sapphires. This is a very common practice being performed on emeralds and corundum now for a long period of time, especially on low quality product having large number of cracks or twin planes.

As compared to coloured impregnation, dyeing refers to enhancing or changing the colour of a material by adding a colour causing agent with a low temperature heat where the colouring agent is attached chemically to the host material, the agent evaporates leaving the pigment into the pores or *cracks of the material being treated.*

As per CIBJO, Dyeing refers to alteration of colour by dyes or other colouring agents, or stones darkened by the "sugar/acid" process.

Now, when we look at a stone impregnated with coloured oil it should be termed as a dyed stone as per the explanation given by CIBJO.

As the Jaipur or Indian gem traders /market is concerned, a large quantity of emeralds are filled with coloured oil- what known as 'Jhoban', while in case of rubies they are commonly dyed or impregnated.

The controversy now arises when such stones are identified or certified. Impregnation or dyeing is identified on the basis of magnification, UV fluorescence, visible and infrared spectra.

***UV Fluorescence**: Variable; Rubies: a patchy orange red; Emeralds: whitish / yellowish / bluish.*

***Magnification**:* Following features to be observed:

- Surface reaching fractures
- Iridescent colours along the cracks / twin planes
- Trapped gas bubbles
- **Colour concentrations along the cracks.**

***Visible spectrum**:*

Rubies: a broad band at 600 nm with no doublet in red region.

Basically, coloured impregnation and dyeing are one and the same, hence a clear differentiation is not needed but this adds to the controversy, since there is a huge price variation between the two especially, when one talk about rubies or sapphires or emeralds.

At GTL, Jaipur we certify these both methods of colour enhancement on the basis of degree of colour concentrations in the fissures or cracks.

- If the amount of colour is minor to moderate, the stone is certified as '**Natural**'.

Comments:

"Red/ Green/ Blue colour along the crack seen"

- If the amount of colour is major or significant, the stone is certified as '**Dyed**'.

Comments:

"This specimen exhibits artificial concentrations of red/ green/ blue colour."

This differentiation is being made keeping in mind the local trader / market, since most of the corundum and emeralds are being filled with coloured oil 'jhoban', which is acceptable in the local market but not in the international, where virtually every jhoban treated stone is considered as 'Dyed stone'.

No matter how much we discuss on differentiating between these two techniques of colour enhancement, *the baseline is that both these are same and doesn't make any difference to the international market.*

Since, Jaipur gem market is one of the most important centers in the world, the use of coloured oil should be clearly mentioned while trading..... this would definitely add to the goodwill of Jaipur as a gem center.....

Some Interesting Stones Tested at GTL.....

Plastic Coated Quartz: Recently, a number of plastic coated quartz has been encountered in various colours ranging from aquamarine blue to citrine yellow to amethyst violet to spessartite orange. Few samples were coated completely from all over while few were coated partially only at the base. When the partially coated samples were observed carefully, the colourless part of quartz was clearly visible with the coloured plastic giving body colour to the stones.

All these specimens had a dull luster of plastic with bluish / yellowish surface UV fluorescence. All the samples exhibited the characteristic Bull's eye optic figure concluding the base material as quartz, RI (in partially coated samples) Top: 1.54, Base: 1.52 (indicating glass / plastic), while completely coated samples gave readings at 1.52. Under magnification, all the samples exhibited a dotted inclusion pattern in plane just below the surface indicating coating.

Along-with the infrared spectra, which gave the characteristic peaks in the region 4000 to 5000 cm^{-1}, placing a hot needle on an inconspicuous part of the sample conclusively identified the coated material as plastic.

Ruby in Serpentine: A hexagonal ruby crystal in green Zoisite is quite common to encounter but not in green Serpentine. This material was recently submitted at GTL for certification. This ruby crystal was surrounded by green coloured material, first thought to be Zoisite at the first glimpse but later examination revealed the material as something else because of the greasy / waxy luster due to the lower hardness of the material.

Under magnification, the material exhibited brownish crystals and white cloudy patches, characteristic of serpentine. The ruby part was roughly hexagonal in shape with hexagonal zones of milky sheen associated with rutile silk and/ or dust.

The ruby portion had number of parallel twin planes across the crystal, which was continued in the serpentine portion indicating the effect of crystal growth on its surrounding mother rock. This feature also eliminated the possibility of composite nature and confirmed the material as naturally grown.

Serpentine was confirmed by the refractive index at 1.57 and a weak absorption in the green region at around 490-500nm in the visible spectrum.

Emerald Crystals in Quartz: Emerald and Quartz are commonly found together, as both share the same geology, and these often encounter in one another, especially emerald crystals in quartz rather than quartz crystals in emerald. This is due to the fact that emerald crystallizes at a higher temperature as compared to the quartz; therefore emeralds crystallize first which then traps in quartz.

One has to be careful while certifying such stones as they exhibit the properties of quartz and the presence of emerald crystals can easily confuse with green fuchsite mica found in aventurine variety.

Two such samples have been recently encountered at GTL. These had a characteristic emerald green colour with white patches of quartz. The RI was at 1.54/ 1.55, SG by hydrostatic method measured at 2.68, and a characteristic chromium spectrum.

These properties are constant with the aventurine quartz but the difference was made under magnification which showed the scattered / random arrangement of green coloured crystals as compared to the parallel arrangement of fuchsite mica flakes in aventurine quartz.

Conclusive identification was made on the basis of FTIR spectrum that gave the characteristic absorption pattern of emerald in the regions 3000 to 4000 cm^{-1} and 5000 to 6000cm^{-1}.

Calcite Bead String: Sapphire blue coloured translucent stones in a necklace consisting of two bead strings of fairly good size, weighing 706 carats were identified, as calcite... isn't it interesting!!

The bead size varied from approximately 10 mm to 20 mm in length, translucent, three directional cleavages simulating three directional twin planes of corundum, dull luster due to low hardness. Strong doubling of inclusions and cracks indicated a stone with high birefringence.

The material was conclusively identified by the refractive index along with the high birefringence blink moving all over the refractometer scale; this type of blink is characteristic for carbonate material.

Similar and other unusual colours of calcite are being encountered as cabochons or beads with different patterns and/ or phenomena imitating few expensive materials like sapphires or.....

GTL Annual Awards Function.....20th June 2005

GTL annual awards function was held on 20th June in which diplomas were awarded to the successful candidates in various courses of gem testing laboratory for the year 2004-05. Dr. K.L. Jain, Honorary Secretary, RCCI, the chief guest of the occasion gave away the certificates and awards. The distinguished trade members and the committee members (Jaipur region) also graced the function.

Member in the committee :

Shri Vivek Kala (Regional Convener, GJEPC, Jaipur)
Shri Vijay Chordia (Convener, TEC, Jaipur)
Shri Rajiv Jain (Convener, Colour Stone Panel, GJEPC)
Shri Mehul Durlabhji (Co-Convener, GTL)
Dr. Nawal Agarwal (Co-Convener, JPDC)
Shri Nawal Kishore Tatiwala
Shri Anup Bohra
Shri Ashok Singhi
Shri Pramod Derewala
Shri Sudhir Kasliwal

Following candidates received the trade prizes for the year 2004-05.

- **Durlabhji Education Trust Award** for Best student of the year: Ms. Neha Agarwal
- **Bhuramal Rajmal Surana Award** for Best student of the year in practical: Mr. Sandep K. Vijay

Results.....Diploma Batch No 33

1. Rahul Guwalani - 1st Overall
2. T. Hari Prasad - 1st Practical
3. Jitesh Tanwar
4. Anand Sagar Agrawal
5. Manish Kumawat
6. Saurabh Tulsyan
7. Shiva Khandelwal
8. Nidhi Jain

Certificate Course

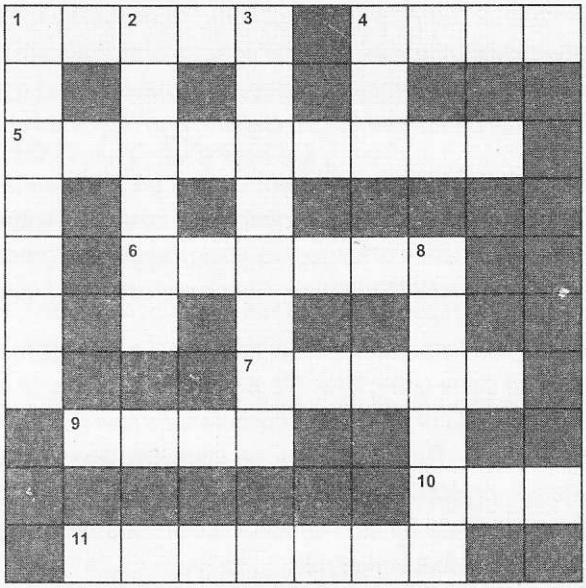
1. Dr. Meenakshi Sharma
2. Vikas Agarwal
3. Siddarth Bhansali

Masters Diploma in Gem Identification

	Th	Prac
1. Chaman Golecha	B	A
2. Vikas Taneja	B	B
3. Seikholen Haokip	B	B

GTLians' Corner.....

Cross word



HINTS :

Across :

1. a gem material known for its flora & fauna inclusions (5)
4. an element defines a variety of spinel as Gahnite (4)
5. a variety of garnet with strong absorption at 505, 525, 575 nm. (9)
6. the best source for Sunstone (6)
7. the first manufacturer of synthetic stars (5)
9. inferior quality of Chinese non-nucleated cultured pearls (4)
10. an acronym used for a source for light in many electronic instruments (3)
11. a gemstone with strong colour zoning and fissures (7)

Down :

1. a snail producing highly iridescent pearls/ shells , also known as paua (7)
2. a type of coral commonly used as jewelry purpose with bamboo like structure (6)
3. a type of a facetted, flat cut commonly used as beads (8)
4. first name of the scientist who started glass filling in diamonds.(3)
8. spherical nut like mass in which opal is commonly found (6)

ANSWERS :

Across: 1. amber, 4. zinc, 5. almandine, 6. Oregon, 7. linde, 9. rice, 10. LED, 11. kyanite.

Down: 1. abalone, 2. bamboo, 3. rondelle, 4. zvi, 8. nodule

What's running these days: - Trend...Translucent.... Sky Blue...

In most of the international / national trade shows or magazines sky blue coloured gemstones are regularly highlighted in various transparencies ranging from transparent to opaque. Here, the emphasis is being given on translucent to opaque gem materials. Few of such materials are Aquamarine (currently a large quantity of translucent varieties are supplied from Brazil), Chalcedony (natural and dyed), Opal (natural and dyed), Turquoise (natural / reconstructed/ treated), Devitrified Glass, Calcite, and Hemimorphite.

Most of the stones listed above can be separated easily form one another with some problems encountered in the identification of dyed chalcedony or turquoise without the use of any analytical technique. The major problem lies in the identification of turquoise when conclusive proofs are not available to differentiate between natural or impregnated or reconstructed turquoise. Elemental analyses can conclusively differentiate between these.

Out of the listed stones few acts, as a simulant for each other therefore individual identification is necessary, which may be done using their RI, SG and inclusions or structure. Aquamarine can be identified on the basis of RI at 1.57-1.58 and SG of 2.70 with characteristic rain like inclusions, Opal and Chalcedony can be differentiated on the basis of RI and SG; Turquoise may be identified by its characteristic colour, structure and spectrum, Glass on the basis of whitish crystallites of devitrification, Calcite by three directions of cleavage with strong birefringence blink and Hemimorphite by its characteristic fibrous radiating pattern. The properties of the commonly available materials are given in the following table.

Stone	Optic Character	RI	SG	Inclusions / Other Features
Aquamarine	DR, Uniaxial	1.57- 1.59 D.R. 0.010	2.70	Rain like inclusions, Iridescent liquid films, fingerprints, phase, etc...
Chalcedony	DR, AGG due to structure	1.54 Weak blink	2.58-2.62	Banding, aggregation in Immersion
Chalcedony (Dyed)	DR, AGG due to structure	1.54 Weak blink	2.58-2.62	Banding with colour concentrations *Spectrum*: Band (s) at 650 , 580, 540
Opal	ADR/SR AGG due to structure	1.45 1.47 No blink	1.98 2.20	Cloudy inclusions, dendritic patterns
Opal (Dyed)	ADR/SR AGG due to structure	1.45 1.47 No blink	1.98 2.20	Cloudy inclusions, colour concentrations, *Spectrum*: Band(s) at 650, 580 , 540
Turquoise	DR, AGG due to structure	1.61 (spot) Blink present	2.40- 2.90	White cloudy patches on darker background, brown/ black matrix, pyrite crystals. *Spectrum*: line at 432nm
Reconstructed Turquoise	DR, AGG due to structure	1.61 (spot) Blink present	2.30 2.60	Dark Blue spots on a lighter background. Conclusive identification with elemental analyses.
Hemimorphite	DR, AGG due to structure	1.61- 1.63 D.R. 0.020	3.44	Fibrous Radiating Pattern in planes originating from different centers.
Glass	SR AGG due to inclusions	1.45 1.60 SR	2.40 2.80	Gas Bubbles, Coloured Swirls, Hemispherical pits, Devitrification effect.

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

Contact for further details : **Mustaqeem Khan**, *Asst. Director (Tech. & Training)*
Meenu Brijesh Vyas, *Asst. Director (Tech. & Training)*
Radhamani Amma, *Asst. (Coordination & Info.)*

Rajasthan Chamber Bhawan
M. I. Road, Jaipur, India
Phone : 91-141-2568221,2573565
email: gtljpr_jp1@sancharnet.in