
LAB INFORMATION CIRCULAR

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GTL.... A look at the activities...

Incorporation: The Gem Testing Laboratory is a project of the Gem & Jewellery Export Promotion Council, sponsored by the Ministry of Commerce & Industry, Govt. of India. GTL came into existence in the year 1972 on 12th day of August, by the extensive efforts of **(Late) Padmashri Khailshankar Durlabhji**, the then convener of GTL and the founder chairman of the council.

Since its inception, GTL has made a gradual progress under the leadership of **Shri Rashmikant Durlabhji**, with the hard-hitting support of **Smt. Shyamala Fernandes**-the In charge of Laboratory (1990-2003).

Currently, GTL is being helmed by the traders of Jaipur, under the leadership of **Shri Kishandas Maheshwari**, Convener-GTL, well supported by the following committee members:

1. Shri Mehul Durlabhji -Co-Convener- GTL
2. Shri Vivek Kala
3. Shri Nawal Kishore Tatiwala
4. Shri Anoop Bohra
5. Shri Rajiv Jain
6. Shri Ashok Singhi
7. Shri Manoj Dhandia

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Activities: The major activities involve certification of stones and to train people.

Certification: GTL was incorporated in the Gem & Jewellery in order to serve the trade by way of certification of stones.

Since its inception, there is a gradual increase in the number of stones, especially during the last three years. Here is a comparative chart....

| Year | No. of Stones |
|----------------|--|
| 2001-02 | 3176 + Bead string 235.00 cm |
| 2002-03 | 4040 + Bead string 80.00 cm |
| 2003-04 | 3136 + Bead string 10.00 cm (Till Date) |

Courses: In order to train people from the market for a better understanding of gemstones, Gemology courses were commenced in October 1990 with the Diploma Course in Gem Identification with 8 students. In the last batch, there was an overwhelming response of 40 students. Later on short course on different individual stones, certificate course and the Masters' course were started in order to make the technical background of a student more stronger.

A comparative chart....

| Year | No. of Students |
|----------------|-----------------------|
| 2001 02 | 91 |
| 2002 03 | 132 |
| 2003 04 | 80 (Till Date) |

Contributions to the Trade: GTL is actively involved in the trade contributions by way of participating in the seminars & conferences held in India and Abroad. During the **ICA congress, Jaipur 2003**, A total of 565 single stones and 608 inches bead string were tested in December 2002, which were put up for auction. Smt. Fernandes- on Asian Sub- Continent & Review of Gemstones Tested at GTL, Jaipur, presented papers.

During the Jaipur Jewellery show, GTL contributed to the trade by way of giving verbal opinion on the stones purchased over there Free of cost.

TREATMENTS ONLY FOR NATURAL GEMSTONES ??????

The term treatment refers to any sort of modification performed on lower grade gemstones to increase their sale ability and therefore their value.

There are a number of treatments which are being regularly performed on different types of stones like, bleaching, coating, foiling, fracture filling- oil / resin / glass / borax coloured / colourless, heating, diffusion, laser drilling, irradiation, etc.

The treatments were initiated on natural gemstones only but with the development of synthetic gemstones, they are now applied on them even.

When one encounters a stone, the first priority is to identify that particular material then a treatment, if any. However, if that stone is a synthetic, then no one bothers to check for any sort of treatment.

This policy of ignoring the detection of treatment in synthetic stones has to be changed, as there are a number of synthetic stones on which treatments are being performed, especially the corundum group.

In a number of cases, the stone is inclusion free or a particular inclusion is very difficult to observe even at a high magnification to call it a natural or synthetic. Therefore, in such cases, for example, if one, encounters diffusion treated blue sapphire, he would simply call it a natural rather than a synthetic because he does not expect that treatment in a synthetic stone.

Few Examples of treatments on synthetic stones.....

Corundum

1. Heat Treatment: Heat treatment is being performed on corundum ruby / sapphire for decades to enhance / change the colour / clarity of the stone.

Gem Materials looking for their own identity !!

Its being a long time since few gem materials have come into the market, but still have not got their own identity as they are used to imitate any other well- known gem material.

Under this category, few stones are **fuchsite**, **hemimorphite**, **prehnite**, **vesuvianite (idocrase)**, etc.

Due to the continuous increase in the exploration, the newer minerals are reaching the market on a routine basis in the similar proportion. However, these minerals are sold in the name of some other well-known minerals.

The reason for this might be the lack of knowledge of explorer or he wants to make more money by selling these minerals as something else. Along with the knowledge of explorer, the knowledge of the traders also matters a lot, as they are the one who purchases these stones and sell these as, what they are not.

Out of a long list of such stones the above listed stones are only a few, which are now become a routine feature in the testing at Gem Testing Laboratory, Jaipur.

The similar situation existed even in the past, when spinel was discovered. Many then mistook it for ruby, later on it was named spinel, and now today, the time has come when spinel has its own identity. But the scenario has changed from that time to the present day, due to technological advancements in the field of gemology.

Today, the mentioned stones are sold as simulants for other stones like, *fuchsite is sold as emeralds or nephrite while hemimorphite is sold as turquoise, prehnite as jadeite and vesuvianite as peridot.*

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- **Flame Fusion** : The major identification features of these stones are curved lines in ruby and curved colour bands in blue sapphire or Plato lines in colourless or light coloured corundum.

Removal of Inclusions ...

- The visibility of these inclusions is minimized on heating.
- The cause of **curved lines / curved coloured bands** is the junctions / impurities between the successive layers during the growth.
- The cause of **Plato lines** is the half way twin planes along rhombohedral faces.
- Heating the stones at around 1400°C to 1600°C for 24 to 30 hours in oxidizing atmosphere will recrystallize the stones, dissolving any concentration of the impurities and the spaces between the successive layers/ twin planes.
- If these inclusions are not visible, the identification of the stone becomes extremely difficult.

Adding Inclusions...

- **Quench Crackling** : Adding cracks to a clear transparent stone to give it a more natural appearance.
- Stone is heated at around 1000°C to 1200°C for 3 to 4 hours and plunged into water. Sudden change in the temperature crackles the stone.
- These cracks give appearance of the fingerprints in natural stones to an untrained eye.
- These stones are left as it is or... **Fracture Filled**.
- The stones are re-heated at around 1200°C to 1400°C for 72 hours in colourless flux say borax.

- On heating borax melts and penetrates into the cracks giving appearance of healed fingerprints as found in heat-treated natural stones.
- These treated stones can be identified visually by the chequer board pattern formed in the process of crackling.



- **Flux Fusion** : The heat treatment performed on flux fusion stones does not affect the identification part, as treatment is done to improve the colour of the stone.
- Few of the flux fusion rubies contain a strong purple / violet overtone like those of Ramaura, Douros, etc, which is undesirable for a ruby even if the stone is synthetic.
- This purple / violet overcast colour can be removed by heating the stones at around 1600°C to 1700°C for 45 minutes to 60 minutes in oxidizing atmosphere.
- The resultant material is much purer red.

1. Diffusion Treatment: The term diffusion treatment refers to the diffusion of some impurities in the lattice of the stone through heating to change the colour of the stone.

Change of Colour.....

- A Colourless sapphire is treated to turn blue or even red. Up to the date synthetic diffusion treated rubies have not been encountered but blue colour is running in large amounts.

- A colourless sapphire is coated with slurry of metallic oxides titanium / chromium kept in a crucible filled with pure aluminium oxide and a flux and heated at around 1700°C to 1800°C for 48 to 60 hours.
- The presence of gas bubbles and Plato effect can identify the material and treatment by patchy colouration, but heating reduces the visibility of Plato effect making the identification more difficult.

Diffusing Star...

- Just treating the material rather than adding the star producing material in the feed material can create a synthetic star sapphire.
 - Titanium oxide with some iron oxide is diffused into the stone at high temperature of around 1500°C in oxidizing atmosphere.
 - This material is reheated at around 1600°C for 72 hours so that titanium re-crystallizes itself in the form of fine needles/ particles along the crystallographic axis in 60° /120° giving a six rayed star.
- 2. Grooving:** Fine grooves- 2/3/4....directions are made on the surface of a cabochon cut stone, which enables the light to reflect, giving a star effect.
- Reflecting the light off the surface can identify the treatment.
 - The grooves can be seen easily.

Emerald

1. Fracture Filling: The use of oil / resin / polymers/ or a combination of these in the surface reaching breaks to make them less visible.

- The treatment is being performed on all the quality grades, and the identification becomes very important in high-grade stones as it affects the prices a lot.
- Recently few high-grade synthetic emeralds have been encountered on which fracture filling had been done.
- Under a microscope, only the surface break was visible with clear violet/ pink flashes indicating resin. No other inclusions were visible, but when the stone was immersed in a liquid chevron pattern was observed indicating the nature of the material as synthetic processed by hydrothermal technique.
- In such cases, there is more concentration on the treatment rather than the inclusions, which might make the observer to interpret wrong results.]

Opal

Treatments like sugar, smoke and foiling, are performed to enhance the body colour and the optical effect, "play of colour" in opals. A light coloured opal is treated to turn into dark coloured or black so that the play of colour enhances.

1. Sugar Treatment: The carbon from sugar is impregnated into the pores of opal to make the body coloured darker.

- Opal is boiled in sugar solution cooled down-heated to 100°C in sulfuric acid cooled down. The sugar burns out in the acid and leaves carbon in the pores giving a darker body colour.

2. Smoke Treatment: Smoke is impregnated into the pores of opal to make the body colour darker.

- Newspaper and a metallic foil is wrapped over the Opal and heated under a flame. Heating makes the smoke from the newspaper to penetrate into the pores of opal.

3. Foiling: Opal is foiled back with a coloured material to enhance play of colour.

- The major identification feature of synthetic opal is the lizard skin effect, whose visibility when impregnated by sugar or smoke gets reduced, making the material difficult to identify.

Diamond

The experiment of **HPHT** treatment begun on synthetic diamonds to change the colour, later on then the treatment started on natural as well and now has created a major problem throughout the world for its identification.

The treatments discussed above are only the few examples, which are being performed on common stones encountered and can be performed on any stone.

There are other treatments like foiling and coating, which are done on many low quality materials, especially on glass to imitate a precious stone in different colours and are commonly used in closed back setting, in enameled jewellery.

A natural stone is treated in order to enhance the appearance the colour and clarity, making it more saleable while a synthetic stone is treated to deceive a jeweler / gemologist, making the material difficult to identify by reducing the visibility of inclusions / or other identifying features.

Be careful! , if you encounter a treatment in a stone, the material could be synthetic.

Therefore, the identification of these materials is equally important to save oneself from being deceived, and can do a fair deal. Here are few features....

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Fuchsite

The stones encountered were translucent, emerald green giving appearance of a low quality emerald. On observing the stone carefully, even with the naked eyes, fibrous/ flaky structure with reddish brown crystals were visible, which can be taken as the characteristic feature of the material.

Using the hydrostatic method, specific gravity measured was just around 2.85, very close to emerald (slightly higher) and nephrite jade. The material was AGG under polariscope and refractive index 1.58 (spot), with a low birefringence of around 0.010.

The properties are very close to that of emerald and nephrite as well, therefore, a careful examination is required in order to distinguish fuchsite from these materials.

| | Fuchsite | Emerald | Nephrite |
|-----------------------|--------------------------------|------------------------------|---------------------------------|
| <i>Composition</i> | Aluminium Silicate | Beryllium Aluminium Silicate | Calcium Magnesium Iron Silicate |
| <i>Crystal System</i> | Monoclinic | Hexagonal | Monoclinic |
| <i>Hardness</i> | 2.5 -4 | 7.5 -8 | 6 -6.5 |
| <i>S.G</i> | 2.80 2.95 | 2.68 2.80 | 2.90 3.02 |
| <i>Pleochroism</i> | Not visible | Moderate to strong | Not visible |
| <i>R.I</i> | 1.58 1.59 | 1.57 1.60 | 1.60 1.63 |
| <i>Birefringence</i> | 0.010 | 0.0060.009 | 0.030 |
| <i>Spectrum</i> | Chromium (similar to emerald) | 683/680, 637, 625, 580, 475 | 689, 498, 460, 509 |

Hemimorphite

Translucent to semi translucent, turquoise blue materials are commonly encountered, but the material is also found in colourless, gray and yellow- brown varieties.

Hemimorphite can be mistaken easily for turquoise, if not observed properly. On close examination, the material has fibrous structure radiating from different points. observed properly. On close examination, the material has fibrous structure radiating from different points.

A comparison.....

| | Hemimorphite | Turquoise |
|-----------------------|---------------------|----------------------------|
| <i>Composition</i> | Zinc Silicate Oxide | Copper Aluminium Phosphate |
| <i>Crystal System</i> | Orthorhombic | Triclinic |
| <i>Hardness</i> | 4.5 5 | 5 6 |
| <i>S.G</i> | 3.4 3.5 | 2.6 2.9 |
| <i>Cleavage</i> | 1 direction | None |
| <i>RI</i> | 1.61 1.63 | 1.61 1.65 |
| <i>Birefringence</i> | 0.010 | 0.040 |
| <i>Spectrum</i> | None | 432 nm |

The structure can easily identify the material with specific gravity as the conclusive aid.

Prehnite

The colour of Prehnite is usually green with fluorescent effect, but brown colour is more common. The green material has the visual appearance of jadeite, jade. Other colours are yellow, yellow-gray, white, colourless.

Prehnite also has fibrous structure in radiating manner in different planes, which could result in a cat's eye if oriented properly while cutting as a cabochon.

Jadeite can be differentiated from Prehnite because of higher specific gravity of 3.33 and the structure.

Prehnite vs. Jadeite

| | Prehnite | Jadeite |
|------------------------|----------------------------|---------------------------|
| <i>Composition</i> | Calcium Aluminium Silicate | Sodium Aluminium Silicate |
| <i>Crystal System</i> | Orthorhombic | Monoclinic |
| <i>Hardness</i> | 6 6.5 | 7 |
| <i>S.G</i> | 2.80 3.00 | 3.30 3.36 |
| <i>Cleavage</i> | 1 direction | None |
| <i>RI</i> | 1.62 1.65 | 1.65 1.68 |
| <i>Birefringence</i> | 0.021 0.033 | 0.013 |
| <i>Spectrum</i> | None | 437.5 |
| <i>UV Fluorescence</i> | White / yellow | none |

Vesuvianite

Vesuvianite is also known as Idocrase, and is oily green in colour, transparent to opaque. Frequently the material also comes in greenish brown-to-brown colours similar to peridot. Therefore, this material is sold as peridot, especially in the Jaipur market, as recently the material is explored in Udaipur region of Rajasthan and Jaipur is the nearest gem market to this place.

Vesuvianite can be identified on the basis of spectrum, RI with birefringence from peridot, which has a higher birefringence and a characteristic three-band spectrum at 453, 473, 493 nm.

| | Vesuvianite | Peridot |
|-----------------------|----------------------------|-------------------------|
| <i>Composition</i> | Calcium Aluminium Silicate | Magnesium Iron Silicate |
| <i>Crystal System</i> | Tetragonal | Orthorhombic |
| <i>Hardness</i> | 6.5 | 6.5 7 |
| <i>S.G</i> | 3.32 3.47 | 3.34 |
| <i>Cleavage</i> | None | Weak |
| <i>RI</i> | 1.713- 1.718 | 1.654 1.688 |
| <i>Birefringence</i> | 0.005 | 0.036 |
| <i>Spectrum</i> | 461nm | 453, 473, 493nm |

These newer gem materials can be differentiated easily from the existing common counterparts on a careful examination, but only the separation should not be the aim.

All these stones must be used as what they are, rather than as a stimulant for something else. By adding these materials to the stone list, a jeweler commonly uses, will give him a lot more options in the selection of stones for his jewellery at a cheaper? Rate

Field Visits....

- The students of Diploma course (Batch 28 / 29) visited the Garnet mines located around the Tonk region in Rajasthan.
- The students of Masters' Diploma (Batch 5/ 6) visited the Emerald mines located around Ajmer and Beawar region at Rajgarh and Bubani.
- These visits were very helpful, as these visits provide a fair practical knowledge of extraction of gemstones from the earth - the risks involved, methods of mining, etc.

Results

Following candidates have been declared successful in the Gem Identification courses.

Diploma - 28th Batch : June 2003 to October 2003

1. Naveen Kumar Shukla 1st Overall
2. Himanshu Jain 1st Practical
3. Chetan Aggrawal
4. Dashleen Aggrawal
5. Gulshan Verma
6. Ira Aggrawal
7. Narendra Singh Yadav
8. Sayed Shakir Ali
9. V. Khiran Kumar
10. Veeravalli Suresh

Diploma - 29th Batch : June 2003 to October 2003

1. Neeraj Dusad 1st Overall
2. Niranjan Data 1st Practical
3. Aashish Damar
4. John Christopher McDonald
5. Kushal Darbari
6. Manish K.
7. Priyanka Bhargava
8. Piyush Bhansali
9. Shamta Aggrawal

Certificate Course in Gem Identification

1. Hemant Korani
2. Montu Gautam
3. Sadhana Mehta
4. Savita Aggrawal
5. Sujata Baheti

Master's Diploma In Gem Identification

1. Chandan Arora Th: A Prac: A

Diploma in Gemmology Gem A (U.K.)

1. Amita Goyal Preliminary
2. Chetna Mathur - Diploma

CONGRATULATIONS TO ALL OUR STUDENTS AND WE WISH THEM ALL THE VERY BEST IN ALL THEIR FUTURE ENDEAVOURS.

WE HOPE THEY WILL MAKE A VALUABLE CONTRIBUTION TO THE GEM & JEWELLERY TRADE.

Our Grateful Thanks...

We are highly obliged to **Shri Rahimullah Khan**, (M/s. Vaibhav Gems Ltd.), **Shri Satish Saklecha** **Shri S.K. Ajmera**, **Shri Rajesh Ajmera**, (M/s. Amrapali), **Shri Vijay Chordia** (M/s. Chordia Gems) and **Shri Vivek Kala** (M/s. Kala Gems) for providing In House Training for students of the Master's Diploma. Their continued support and encouragement is deeply appreciated.

Seminars and Conferences

- At the 5th Indian Gemological Seminar held at Bhubaneswar, Orissa, Shri Gagan Choudhary, Asst. Director Technical & Training, presented a paper on "HPHT-An Overview" on behalf of GTL.

The seminar held for five days from 28th October to 1st November 2003. The gemologists from all over the country participated in this particular seminar with their papers on different topics of their interest and related to every aspect of Gem & Jewellery Industry.

- GTL, Jaipur organized a seminar on "Hindi Divas" celebration on 23rd September 2003. The chief guest for the occasion was **Shri Kishandas Maheshwari**, (Convener, GTL), **Shri Nawalkishore Tatiwala** (Member, GTL-working committee) and **Shri Sanjay Singh** (Regional Director-GJEPC, Jaipur) were the other two judges.

The students of GTL participated in the seminar and presented their ideas on "Gems and astrology". Shri Anuj Ganeriwal won the first prize while Shri Sayed Shakir Ali, the second. All the speakers got the consolation prizes.



Stone News - what's moving these days

Some interesting stones through GTL.....

Triangular markings on Synthetic Ruby crystal

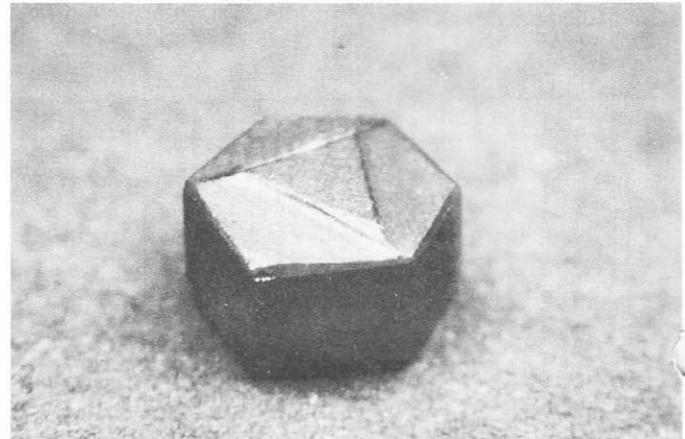
Triangular markings are quite common in synthetic ruby by Flux fusion process that creates a lot of confusion, but what if the stone is produced by flame fusion process. Recently, we have encountered such one stone.

Typical ruby colour/ shade, hexagonal in shape with triangular growth hillocks on basal pinacoid, but no criss-cross striations!!!

No inclusions were visible under a microscope, but when the stone was immersed in Methylene Iodide, curved lines were clearly visible confirming the nature of material as synthetic by flame fusion process.

The surface of the material was very smooth, clearly indicated that the material has been cut, and the markings have been artificially created. There were no striations on the crystal faces, which are characteristics for a natural stone especially, if the stone has got triangular growth hillock.

Be alert!!! If you are encountering a rough crystal with proper surface markings, they could be artificially created and the stone could be synthetic.



Gemstones

Colour Changing Fluorite:

It is not common to hear/ encounter the colour changing variety of Fluorite. Recently, two samples of colour changing fluorite have been submitted at GTL for testing. The body colour of the material was bluish green in daylight but when it was exposed to incandescent light it turned to purplish red. This colour change is very similar to that observed in alexandrite from Vishakhapatnam. The visual appearance of the stone was very similar to that of alexandrite because of the body colour, but the surface luster was quite low due to the lower hardness of 4 on Mohs' scale. The gemological properties were exactly that of a fluorite, which confirmed the identity.

Calcite Sphere : When any one talks of calcite, the first thing comes in the view is the lower hardness, doubling effect and the appearance of the rough crystal. Here at GTL, a colourless sphere weighing 9257.50 carats was submitted for testing. At the initial observation, the sphere appeared to be either glass or rock crystal. But, on careful examination, a cleavage plane was observed with iridescent effect and doubling. Later on, complete three directional cleavages became visible. Refractive index at 1.56 with a typical carbonate blink was observed, which concluded the stone as calcite, whereas infrared spectrum confirmed the stone as calcite. This was a quite rare case when calcite is found in clear as well as large sizes.

Fancy Coloured Glasses: Fancy coloured glasses are now a routine feature in testing at GTL.

These glasses are available in a wide range of transparencies, which includes transparent and colour shades exactly imitating stone like sapphire, aquamarine, topaz, tourmaline, tsavorite, ruby, etc.

Some glasses are opaque with colour shades of turquoise, jade, coral, etc.

Phenomenal varieties include opalescence, chatoyancy, and play of colour, sheen, aventurescence and even schiller.

Recently, a cat's eye cut as a sphere weighing approximately 450 carats was submitted for testing which was purchased as chrysoberyl cat's eye turned out to be a glass cat's eye. The stone didn't had the typical honey comb effect but turned semi-transparent when viewed in the direction of fibers. The nature was confirmed by the RI of 1.54 and infrared spectrum typical for glass.