# THE OIL TREATMENT OF EMERALDS IN BOGOTÁ, COLOMBIA

By Ron Ringsrud

*It is well known in the trade that most emeralds on the market today are oiled. This article focuses on Colombian emeralds and gives a detailed explanation of the oiling process as observed by the author. Sophisticated laboratory procedures are compared with common "back porch" methods. The methods used often vary from parcel to parcel, and the success of the treatment depends in part on the experience of the treater, although the process itself appears to be relatively permanent. Observations are also presented on methods of detecting oiling as well as on the use of colored oils.*

ABOUT THE AUTHOR

*Mr. Ringsrud is a gemologist and sales manager of the GEM Instruments Showroom, Santa Monica, CA. He is a former resident of Manizales, Colombia.*

*Acknowledgments: The author would like to thank the following people for their kind help and cooperation: Antonio Barriga del Diestro, Jorge Murcia, Hector and Gerardo Acuña, Hernando Castro, and Jorge Bautista. Thanks also go to Kenneth McCauley for supplemental information and for the photomicrograph in figure 8, and to Eul Cho for one of the Muzo emeralds tested. The photos in figure 1 are by Mike Havstad. John Koivula is responsible for the photomicrographs in figure 7. All other photos were taken by the author.*



The application of treatments and processes to enhance the beauty of gemstones is almost as old as the discovery and appreciation of gems themselves. Records of actual oiling of gem crystals go back as far as ancient Greece (Sinkankas, 1981). The principle of oiling is simply that while air-filled fractures in gemstones are highly visible, a fracture filled with a transparent oil or some other suitable material will be much less apparent. While the oiling changes only the clarity characteristics of the gemstone, the color will naturally be intensified because of the fewer apparent flaws blocking the passage of light. Figure 1 shows the change in both clarity and color in three lower-quality emeralds.

Although it is common knowledge in the gem trade that Colombian and other emeralds are oiled, the process itself is not widely understood. This article will attempt to clarify some of the details of the oiling process as it occurs in Bogotá.

On a June 1983 visit to Bogotá, Colombia, the author had the opportunity to interview several emerald treaters and visit two laboratories in which emeralds were treated by a process that involved the penetration of a colorless oil into the fractures of the stones. One of the laboratories visited represents the most common "back porch" treatment lab. The other, Bargar Gemological Laboratories, directed by gemologist Antonio Barriga del Diestro, is highly sophisticated and complete, providing not only emerald treatment but also cutting, cabbing, gemological quality reports, gem photography, and an attractive gem and mineral display.

While arranging the interviews, the author found that emerald treatment, rather than being a clandestine activity or secret process, is quite freely disclosed. This openness was demonstrated when the author purchased rough emeralds in Chiquinquirá in the Muzo district. When the seller discovered that the stones would be taken to the

*Figure 1. The top photo shows three lower-quality emeralds (0.94–1.85 ct) before they were treated with colorless cedarwood oil. The photo below shows the same stones two weeks after oiling. The visibility of all the fractures has been reduced considerably by the oiling, thereby giving the appearance that the color has improved. On borderline stones, the process could help a green beryl grade up to emerald. Note the heavily fractured areas in the stone on the right and in the center stone. Approximately one month after oiling, the stones were placed in an ultrasonic cleaning tub with warm cleaning solution for three minutes. Except for the one large fracture in the center stone, the effects of oiling proved stable.*

United States, he not only stressed the importance of careful cutting but also sincerely emphasized proper acid treatment and oiling, implying that the emeralds were not "finished" until they had been treated. In Bogotá as well, the largest treatment laboratory, Bargar Labs, posts a fixed pricing schedule for treatment of cut stones and also issues a disclaimer upon receipt of stones for treatment. The disclaimer outlines the possible risk to the stone from "the acids and other elements used in the cleaning process . . . ."

The treatment process, though performed differently from one person to the next, usually begins after the emeralds have been cut. The stones are treated either by the cutter or the dealer himself, or they are sent out for treatment. The actual procedure, though, usually follows a basic five-step program of preliminary cleaning, acid treatment, acid removal, oiling, and final cleaning. Each of these steps is described in detail below. Also discussed is the permanence of the oiling treatment, detection, and the use of colored oil.

## THE OIL TREATMENT PROCESS

**Cleaning.** The most common set-up of a treatment lab in Bogotá is similar to that in the house of Mr. Jorge Murcia, whose family has been in the emerald business for nearly two decades and who has personally been treating emeralds for eight years. Murcia begins the treatment process by cleaning the freshly cut stones, that is, putting them in a test tube with methyl alcohol or ethyl alcohol, bringing them to a boil, then letting them cool slowly (figure 2). They may be boiled and cooled up to three times. This first step is not always necessary (Barriga begins directly with the acid treatment), but Murcia explained that occasionally the emerald rough is oiled to facilitate its sale. Such oil in the fractures of the stone often reacts with the acid, leaving permanent brown stains inside the stone (which resemble the common brownish iron stain inclusions found in some emeralds). If Murcia is certain the rough was oiled before cutting, he leaves the stones in the alcohol overnight. One major cutter in

*Figure 2. The alcohol used as fuel for the burner also serves as a solvent to clean the recently cut emeralds prior to treatment.*

*Figure 3. Fumes from the acid treatment are drawn away by this apparatus at Bargar Gemological Laboratories. The pump below draws a vacuum in the heated beakers.*

Bogotá's emerald district suggests pretreatment cleaning in acetone.

**Acid Treatment.** Tin oxide and chromic oxide that have built up in the fracture openings during cutting and polishing are removed during this and the next step of the process in order to allow for the penetration of the oil into the fractures. In this step, the stones are treated with a mixture of hydrochloric and nitric acids. Murcia uses a 2-to-1 mix of concentrated HCl to concentrated $HNO_3$ in a wide-mouthed pyrex test tube with a screw-on cap. This cap maintains pressure buildup within the test tube, which Murcia feels is beneficial to the penetration and cleaning action. Other treaters use rolled-up newspaper moistened with water as a stopper, which relieves the pressure very slowly but will not pop out as a cork or rubber stopper would. The Bargar Labs puts the stones in a vacuum test tube apparatus (figure 3) rather than under pressure, and leaves them overnight, heating but not boiling. Murcia leaves the stones in the acid overnight but does not heat them. The stones bubble slightly for about two hours as the acid reacts with impurities, residual cutting compounds, and replaces any air left in the fractures.

The pressure buildup in the test tube can be excessive, particularly if the acid is boiled; the treater should, therefore, relieve the pressure periodically, taking care not to breathe the fumes. At this stage of the process, some treaters use an ultrasonic cleaning tub to help the acids penetrate the fractures (figure 4). However, both Barriga and Murcia feel that this is unnecessary. During these early steps, great care is taken with the solvents, which are flammable, and with the acids, which are extremely corrosive and dangerous.

**Acid Removal.** The process continues with the cleaning of the acid from the stones. Generally, this is accomplished by boiling the emeralds or heating them slightly in alcohol, ethyl alcohol, acetone, or paint thinner. However, Barriga feels that water is the best substance for removing the acids. It is also safer because acid-wet stones

*Figure 4. An ultrasonic cleaning tub is sometimes used to help the acid mixture penetrate and clean the emeralds. The cutting and polishing oxides left in the fracture openings would otherwise block the penetration of the oil.*

should not come into contact with solvents unless they are first rinsed and dried. In his treatment lab, Barriga uses small beakers to hold the emeralds in a solution of water with detergent. The beaker is then put in an ultrasonic tub for half a minute and stirred slightly. After the beaker is removed, the stones are left to soak in the solution for several hours. The stones are then rinsed and dried.

**Oiling.** The next step, oiling, is the one that probably varies the most from person to person. Although there are reports that "3 in 1" oil, clove oil, mineral oil, and the like, have been used, the one most highly recommended in Bogotá is the Merck brand cedarwood oil (refractive index, 1.515) or Merck Canada balsam (R.I., 1.52). Although the refractive index of these two oils is below that of emerald (1.577–1.583), it is so close that the oil appears invisible within the stone. The *Merck Index* (Merck, 1976), a standard chemical reference book, describes Canada balsam as a transparent, slightly fluorescent liquid that upon exposure to air gradually solidifies to a solid, noncrystalline mass. It is used either alone or mixed with a small amount of cedarwood oil. Although the properties of Canada balsam are well known in Bogotá, the cedarwood oil is still used the most, since the majority of fractures in emeralds need only a minute amount of oil to reduce their visibility and the cedarwood oil is much less expensive.

Because the oils are quite thick, they must be heated in order to penetrate the stone well. As with the acids, Bargar Labs places the emeralds in with the oil and creates a vacuum in the test tube with the equipment shown in figure 5. The stones are then heated, but not boiled, for several hours. Then, without vacuum, they are baked at 83°C for four hours. Although boiling the oil is more common among independent treaters, Murcia prefers the less harsh treatment of 45 minutes in a "baño maria," that is, placing the test tube in boiling water. The test tube is then immediately exposed to the heat of a 75 watt bulb overnight. To prevent burning, it is placed no closer than one or two inches above the bulb. A tight screw cap or stopper is used to maintain pressure. Low-quality or cabochon material may require several days over the light (figure 6). A less sophisticated method of producing a vacuum in a test tube involves the use of a rubber stopper placed beneath the screw-on cap. A syringe needle is inserted several times through the stopper in order to draw the air out. If done correctly, this method creates such a high vacuum that the oil begins to boil at room temperature. The test tube is then placed in boiling water.

In terms of immediately perceptible results, it seems that treatment with the oil and acid under slight pressure is essentially the same as treatment under vacuum. In terms of long-term results, the vacuum method is probably the most thorough and long-lasting. This process is also faster and more suited to the high volume of emeralds that Bargar Labs treats on a day-to-day

*Figure 5. In Bogotá, Merck cedarwood oil is considered to be most effective for emerald treatment. In this apparatus at the Bargar Gemological Laboratories, the emeralds are soaked in the oil and then heated in a vacuum.*

basis. The majority of dealers send their parcels of emeralds to Bargar Labs, an indication of the quality of the method of treatment performed there. The rest of the independent dealers, like Murcia, treat their stones themselves with variations of the same basic process and with different levels of experience.

**Final Cleaning.** The last step is to dry the emeralds in a paper towel and polish them on a cloth. One dealer, Hernando Castro, says, "Rub them with a handkerchief until they pick up your own charm and they'll sell themselves." One cutter recommends polishing the stones with Vaseline, especially if they were oiled in the thicker Canada balsam. Dealers in Chiquinquirá sometimes carry stones around with them in Vaseline tins for just this reason.

The treaters, by virtue of their experience subjecting many emeralds to the rigors of treatment, become quite familiar with emeralds from different sources and their individual characteristics. For example, all of the emerald treaters with whom the author spoke concurred that Cosquez material is very sound and responds well to treatment. They report that it rarely breaks apart on the wheel or in the ultrasonic tub, and never dries out after oiling.

Muzo material is generally considered less sound, but by no means fragile. Furthermore, emerald mined from different areas and veins of the Muzo mine respond differently to the treatment. For example, stones from the Puerto Arturo section of Muzo are favored by dealers because they respond very well to treatment, whereas those from La Cristaleria have inner feathers that do not disappear even with oiling. Dark inclusions in stones from the Cincha area also do not respond to treatment.

## PERMANENCE OF THE PROCESS

The only time treatment is mentioned among wholesalers is if a particular parcel of emeralds has *not* been treated. Otherwise, on the low- and medium-quality commercial stones it is commonly understood that the stones have probably been treated. Since emerald treatment primarily reduces the visibility of fractures that penetrate the stone from the surface, many fine-quality Colombian emeralds are not treated because of their higher clarity.

Several dealers explained that the treatment is considered a common and acceptable practice since the majority of emeralds have such fine fractures that the oil seldom dries out or, at the very least, the natural oils of the wearer replace the oil in the stone. They maintain that the treatment only slightly enhances the natural beauty of these stones. When confronted with the fact that a small percentage of emeralds do dry out and have had their value misrepresented by the oiling, the dealers replied that the oiling should have been detected by the buyer, either from close inspection with a trained eye (see below for a discussion of detection of oiling), or from the suspiciously low price of the merchandise. As is the case with treated stones from other parts of the world, it is safest to deal with wholesalers who depend on repeat business for their contin-

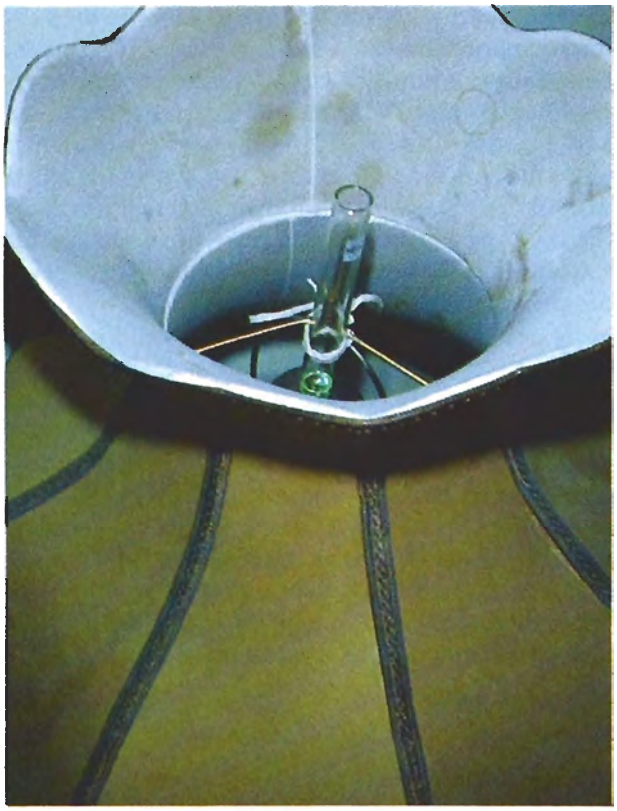


*Figure 6. The lightbulb of an ordinary table lamp provides heat for maintaining the oil at a constant high temperature.*

ued success and who therefore do not willfully misrepresent stones.

The use of Canada balsam versus cedarwood oil, the amount of heat, and other factors vary from parcel to parcel. In this same way, the permanence of the treatment varies with the material and the experience of the treater. In actuality, the percentage of stones that do dry out is impossible to calculate. Probably the only means of determining the extent to which oiling has affected the appearance of the stone is to let the emerald sit overnight in warmed acetone. However, this would be considered a "destructive" test on stones in which the oil would otherwise be stable (i.e., under conditions of normal wear). After drying, all fractures would be visible. Since the maximum drying occurs in the first month after oiling, one might simply determine how long the emerald has been in the jeweler's or dealer's inventory.

One large-volume emerald purchaser in Bogotá says that when he is in doubt he leaves the stones on the windowsill or in a dry, airy place for about two weeks before deciding on the parcel. This is similar to the "fade test" used in the trade for testing the stability of irradiation-induced colors in gemstones, by which stones are placed in sunlight for a number of days to check for color change.

The claims made by Barriga to the author that emeralds oiled by his process can withstand even an ultrasonic cleaning proved to be true in the case of the emeralds shown in figure 1. After three minutes in an ultrasonic cleaner, followed by several hours of drying under heat, there was no significant change in the clarity of the emeralds with the exception of one particularly large fracture.

## DETECTION OF OILING

The gemological literature states that some oils fluoresce a dull yellow under long-wave fluorescent light. Stones oiled by the author with the Merck cedarwood oil did not fluoresce. However, the emeralds oiled with the Merck Canada balsam fluoresced yellow in the oiled areas.

The presence of fractures will interrupt the passage of light somewhat even with oiling. If the stone is less transparent than it seems it should be, sidelighting with a pinpoint illuminator may reveal dull indications of the oil-filled fractures. Since emeralds commonly have numerous subtle liquid-filled inclusions that could resemble oil-filled fractures, the investigation should be confined to fractures that reach the surface of the stone. If an oil with a refractive index significantly different from that of the stone was used, careful manipulation of the lighting while the stone is viewed under magnification will reveal an iridescent effect. If the oil has not penetrated completely, then gaps will be seen. Also, the careful use of the heat from a thermal reaction tester may cause a drop of oil to bead up on the surface of the stone from the fracture (Liddicoat, 1981). A prominent emerald buyer in Bogotá suggests holding the stone papers up to the light and looking for oil spots and signs of oil that may have seeped from the stones.

In rough stones, the dealers smell the stone for the characteristic cedar smell of the oil. They pay close attention to the transparency of the stone. Also, any shale matrix on a stone that has been oiled will appear glossy black from the oil rather than the normal dull black.

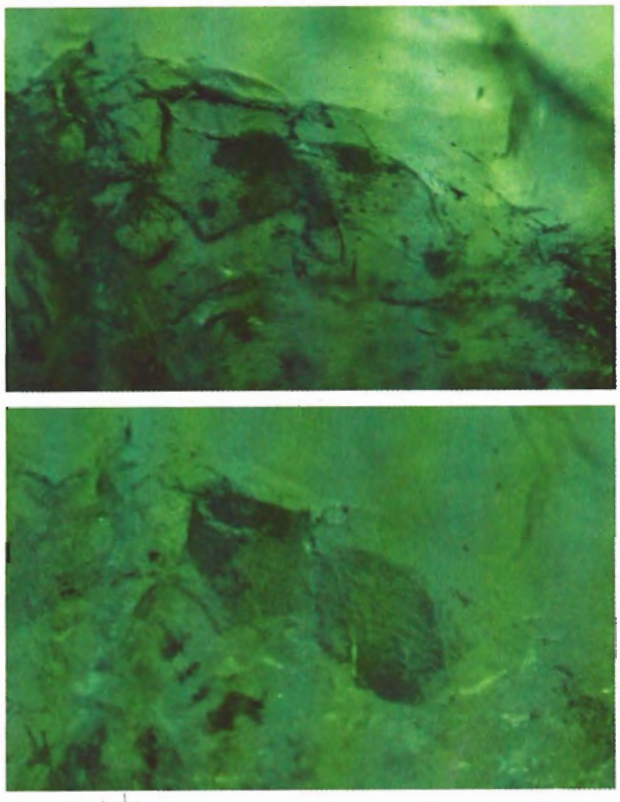


*Figure 7. The upper photo shows a typical air-filled fracture at 40 × magnification. The lower photo shows how a slight change in the angle of the stone to the light source causes the fracture to darken and appear as if it contained dye or colored oil.*

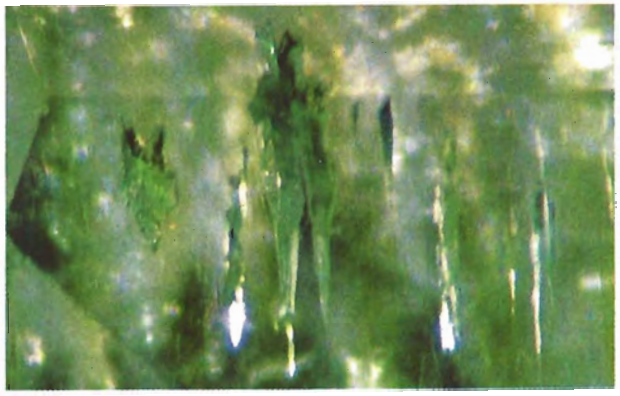
## USE OF DYED OIL

All dealers interviewed held that the introduction of green dye into the oil for the purpose of deepening the color of light stones is an uncommon practice. One reason why the use of green oil may be thought to be more common is the reflectant nature of fractures. The air-filled spaces in the fractures will reflect light from many areas of the stone, thereby magnifying the color that gets reflected. This often gives fractures in emeralds a dark green appearance, and the common conclusion is that green stain or dye has been introduced (figure 7). Richard T. Liddicoat, Jr., commented on this phenomenon in the Summer 1964 issue of *Gems & Gemology:* "These air-filled openings were acting as mirrors and were reflecting a zone of slightly more intense natural coloration, thus creating the illusion that color was in the fracture."

A common method used to reveal dye concentrations in emerald fractures is to place the stone on translucent white plastic over an intense light source (Fryer et al., 1981). The diffused light will reveal any color concentrations. If color concentrations are found in the fractures, they should be investigated further at 10× magnification with transmitted light. It is important to turn the stone in every possible direction in order to determine if the color concentration is from reflection or dye. Generally, when the fractures are turned and light is allowed to pass at a straighter angle (within the critical angle of emerald), the fracture suddenly changes from dark green to colorless. Fractures that are perpendicular to the table of the stone and close to the crown will seldom achieve the necessary straight passage of light because of the refraction of light as it enters the crown. In this case, a conclusion can be reached on the stone on the basis of a survey of fractures in other areas of the emerald. If dyed oil is present, the fractures will seem slightly opaque and will remain green at any angle.

The polishing compound most commonly used by cutters in Bogotá is chromic oxide, which readily enters fractures or hollow tubular inclusions that reach the surface of gemstones and is difficult to remove (Sinkankas, 1972). If this material is tightly compacted, the acid treatment and cleaning process may not remove it, and it may be seen under magnification as dark gray-green forms going in from the surface (figure 8). These buildups of polishing compound, being dark, very localized, and confined to the larger

*Figure 8. The dark material filling the surface fracture in the center of the photomicrograph is actually residual chromic oxide from the polishing process. Normally, this is removed during acid treatment; if not, it may give the appearance of an attempt at dyeing. Magnified 60 ×.*



openings on the surface, should not be considered as attempts to color the stone.

## CONCLUSION

Although the oil treatment has been explained here as a basic five-step process, the experience and skill of the treater still have much to do with the success and permanence of the treatment. While boiling and the use of an ultrasonic cleaner may seem harsh, the treaters have found that if the emerald survives the rigors of cutting, in most cases it can withstand the oil treatment process as well. While permanence will continue to be a problem in some oil-treated Colombian stones, better use of known testing methods and care in buying will lessen the risk.

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