

Colour enhancement of Sri Lankan gem quality quartz by gamma-ray irradiation

P R K Fernando*¹, L R K Perera², C P Udawatta³, S S Kulatunge⁴

¹ Postgraduate Institute of Science, University of Peradeniya, Peradeniya

² Department of Geology, University of Peradeniya, Peradeniya

³ Department of Chemistry, University of Peradeniya, Peradeniya

⁴ Atomic Energy Authority of Sri Lanka, Colombo.

Various techniques like heat treatment, diffusion, impregnation, laser treatment and surface treatment are used to enhance value and beauty of gemstones. Irradiation of gemstones by high- energy radiation such as Gamma rays, X-rays or high-energy particles such as Alpha rays, Beta rays or Neutron beam induces colour in colourless gems or enhances colour of coloured gems. The colour of a gem originates due to three basic factors known as crystal field splittings, charge transfer transitions and colour centers, and it is believed that irradiation enhances the colour by generating colour centers.

This research was carried-out between 01.03.2004 - 30.04.2004, to understand colour enhancement of Sri Lankan gem quality quartz by gamma-ray irradiation. Usually, in irradiation cut and polished semiprecious gemstones are used. Quartz is a semi-precious gem, which is less valued in the market and much in abundance in Sri Lanka, was the main reasons for select it. Although many varieties of quartz is available in Sri Lanka, citrine (yellow), amethyst (violet) and water-clear quartz (colourless) were selected for irradiation, considering their distinct colour differences. Cut and polished stones of varying shapes (ex round, oval, square), but weighing about one carat (200 mg) each were selected for irradiation.

Irradiation of the gem samples was carried-out at the Atomic Energy Authority of Sri Lanka in Colombo. The irradiation source was a Co-60 Gamma irradiator capable of providing an absorbed dose of 7.5 kGy/h (kiloGray per hour). From each variety 10 samples were irradiated. The dose of irradiation on these stones was increased in steps of 5 kGy to reach a maximum of 50 kGy. During the process, water-clear quartz turned into smoky quartz and citrine turned from yellow to brownish yellow, whereas amethyst did not show a significant colour change. Photographs taken before and after irradiation of gems were used to compare the colour changes.

In open market smoky quartz is much more expensive than water-clear quartz thus gamma-ray irradiation is a useful technique for value addition in water clear quartz. But citrine and amethyst did not show any value adding colour change by gamma-irradiation. Anyhow the majority of quartz available in Sri Lanka is water-clear quartz and they can be value-added by gamma-irradiation.

* prkf@eudoramail.com

Tel: 011 2931234