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# Thermoluminescence studies of river sands of Gujarat

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**Abstract**

In Construction Industries for Civil Work Fine Aggregate ie sand is one of the important components for making dense concrete and rich mortar. Sand is mineral particles from natural sources largely the result of braking down of sand stone which contains Mica and $SiO_2$. Silica and Mica are good Thermoluminescence (TL) dosimeter applicable in geology and archaeology. Sand is the Material most of which passes through 4.75MM IS Sieve. Colour of the Sand Vary from deep brown to white. Deep brown colour is due to present of traces of Iron while white colour Sand contains Mica and SiO2. Mica is easily discernable from its shining surface which is above @ 3%. Silica imparts resistance against crushing. Sand having Fineness Modulus ie. FM is in the range of 2.2 to 2.6 which has direct effect on the average surface area of the sand. Presents paper indicate the TL properties of river sand collected from Ambica river, Goyani river, Narmada river and Mahi river. In this study the received sand is subjected to NTL and ATL by giving 10Gy test dose from Sr-90 beta source. All the NTL peaks are in the range 120-160$^oC$ and ATL gives rise a hump at 170$^oC$. Results are interesting and further studies are on.

## 1.INTRODUCTION

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. The composition of sand is highly variable, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or $SiO_2$), usually in the form of quartz.River sand has variety of categories such as Quartz, silica sand containing 99.82 % $SiO_2$, $Al_2O_3$, 0.18% Free Iron, 0.01% $Fe_2O_3$, 0.02% $CaCO_3$, 0.25% loss by weight, with specific gravity 2.8gm/cc.

In terms of particle size as used by geologists, sand particles range in diameter from 0.0625 mm (or 1⁄16 mm) to 2 mm. An individual particle in this range size is termed a *sand grain*. Sand grains are betweengravel (with particles ranging from 2 mm up to 64 mm) and silt (particles smaller than 0.0625 mm down to 0.004 mm). The smallest particle size of Sand as @ 0.02 mm was considered byAlbert Atterberg standard during the early 20th century. In 1953 engineering standard published by the American Association of State Highway and Transportation considered sand sizein the range of 0.074 mm upto 4.75 mm. High quality natural river sand is utilized for most of applications in various Glass Industries. Itimparts moisture resistance shrinkage and creep resistance in brick masonry and smooth plaster works.

In Construction Industries, for Civil Work Fine Aggregate i.e. sand is one of the important components for making dense concrete and rich mortar. Sand is mineral particles from natural sources largely the result of braking down of sand stone which contains Mica and $SiO_2$.Silica and Mica are well established Thermo luminescence (TL) dosimeter applicable in geology and archaeology.

Sand is the Material most of which passes through 4.75 mm IS Sieve as per IS 383. Colour of the Sand Vary from deep brown to white. Deep brown colour is due to present of traces of Iron while white colour Sand contains Mica and $SiO_2$. Mica is easily discernable from its shining surface which is above @ 3%. Silica imparts resistance against crushing. Sand having Fineness Modulus (FM) i.e. FM is in the range of 2.2 to 2.6 which has direct effect on the average surface area of the sand.

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## 2. EXPERIMENTAL DETAILS

The Present TL study of mineral sand is intended to suggest the quality of the material at input stage of the construction. TL dosimeters studies can be done in case any accident like unclear fall out, the sand in the building may be used to get total radiation receiver from the accident day to sample analyzed day.

The present dissertation mainly with sand sample from the followings rivers of Gujarat State

1. Ambica river and Goyani river near BILIMORA
2. Auranga river near VALSAD
3. Mani river VASAD near VADODARA

## 3.RESULTS AND DISCUSSION

The collected sand was subjected to acid treatments using HCl for 2 hours and HF for 40 minutes to etch away surfaceimpurities. Such acid treated sand is washed with Demineralized water (DM)three times to remove acidic traces on the material. The sand isindexed accordingly and thermo luminescence studies were carried out in two separate categories such as NTL (natural thermo luminescence ) and ATL (artificial thermo luminescence ). ATL was recorded by giving 10 Gy ß-dose using Sr-90ß source with known decay rate,to the specimen.

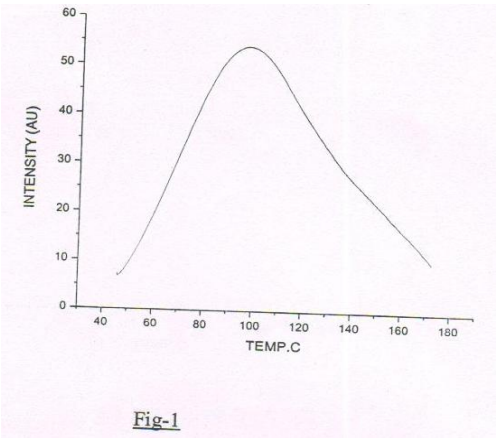


**Fig.1:** ATL of sand collected from Mahi river 10mg. sample irradiated using Sr-90 ß source given a test dose 10Gy.

For all the TL measurements equal volume of sand sample were taken whose weight was around 10mg.Nucleonix thermo luminescence reader was used to record TL of sand sample. 120 μm meshsized sand sample from Mahi River were considered for studies. The natural sample was subjected to 10 Gy ß-dosed and stored 24hours and TL glow curve was recorded . Fig 1 to 6 shows TL glow curves of treated sand specimens.

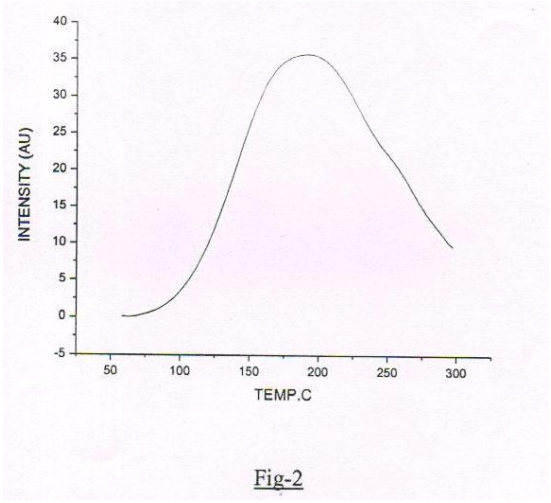


**Fig.2:** TL after irradiation and storage for 24 hours of sand collected from Mahi river.

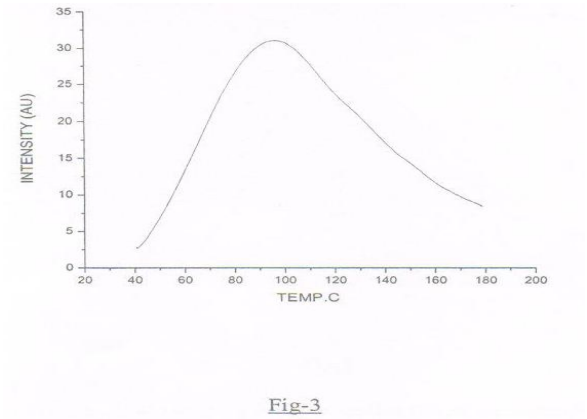


**Fig.3:** TL glow curve of 65 μm acid (HCl) treated sand sample from Mahi river

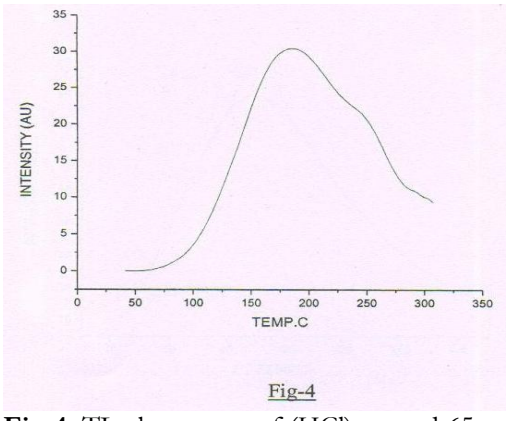


**Fig.4:** TL glow curve of (HCl) treated 65 μm sand sample from Mahi river

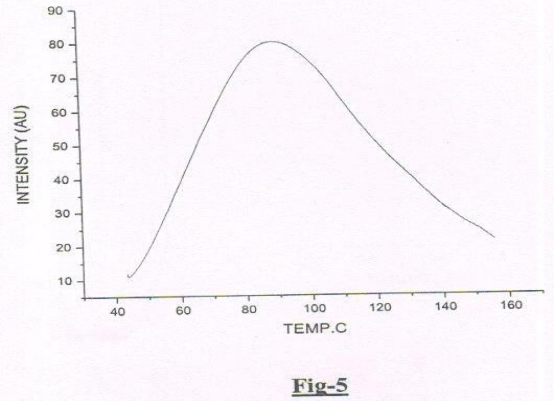


**Fig.5:** TL glow curve ofthe Mahi river sand followed by 10Gyßdose.

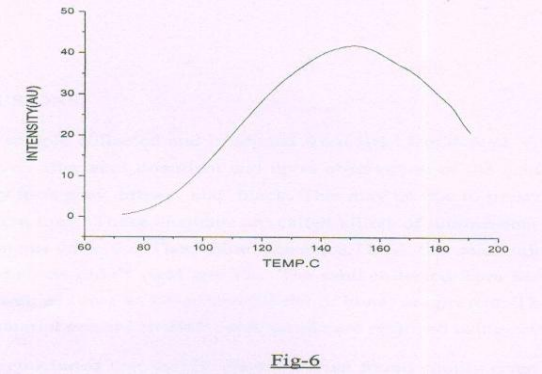


**Fig.6:** TL glow curve of HF treated &ß irradiated sand collected from mahi river

Fig-1 Displayed a wall rssolved TL pack temperature around 100$^0$C. The irradiated sample was stored for 24hours and TL was recorded and presented asFig-2. It was observed that the peak temp was around 190$^0$C. The TL peak observed is a well-reserved one, however the peak intensity is reduced by30% when compared to TL recorded immediately after irradiation. In yet another study of Mahi river sand treated with HCl, found that the TL glow curve is well resolved one and isolated peaking at 100$^0$C. the intensity of TL peak is around 30 units as presented in fig. 3. However, when such acid treated 65 μm sand sample when stored for 24 hours showed intensity around 30 units and a humpat 250$^0$C.

Also assume an isolated TL peaks with peaktemp180$^0$C in fig-3 & fig-4 is found to be the TL peaks are originated from Mahi river HCltreated 180 μm sand after irradiation with ß source giving a test dose 10Gy.On comparing fig-3 & fig-4, the TL peak temperature of stored sand sample whose peak temperature is 180$^0$C with intensity of 30 units whereas,acid treated sand sample without storage (fig-3) showed peak temperature is 100$^0$C with intensity of 30 units.The change in peak temperature may be due to the TL trapping and detrapping upon storage of the irradiated mineral and finally emerged at 180$^0$C peak along with hump at 250$^0$C.

Fig-5 and fig-6 are the TL of 10Gy ß dose given sand samples are collected from Mahi River. The sand are subjected to HF treatment for 40minutes and washed with DM water before recording TL studies.

HF treated Mahi river sand when exposed to 10Gy ß dose displayed well resolved isolated peak with peak temp. 90$^0$C & intensity 80 units. But after due storage of 24 hours (Fig-6) such HF treated Mahi river sand recorded a broad isolated peak with temperature 150$^0$C&intensity 40 units are observed. On comparing fig.(5) & (6) it is discerneable that the TL peak intensity I reduced by 50% & peak temp. was shifted to 150$^0$C after 24hours storage of sand sample.

## 4.CONCLUSIONS:

The sand sample collected and irradiated from BILLIMORA & VALSAD did not yield any TL even after Acid treatment and upon observation of the sand grains of this three rivers they look grey, brown and black. This may be due to presence of iron (Fe), cobalt & chromium ions.

The sand minerals collected from these three rivers didn't yield any.

It is also concluded that the TL observed than found simply river MAHI sand are only due to quartz & feldspar present in the mineral sand. The TL peaks observed from 90 C to 180 C are mostly arising from quartz. Since the sand minerals contain many impurities in the quartz grain, this lead to variztion in TL peak temperature of immediately irradiated & 24 hours stored samples.

It is concluded that the sand present in the riverbeds can be considered for TL dosimeter in accidental fallout of nuclear materials. It is also observed that sand having good TL value offered good resistance toward crushing shrinkage and creep in concrete. Hence we can correlates engineering parameters with Thermo luminescence parameters for making good quality of concrete by selecting appropriate aggregate having high TL value.

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