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Using LST Heavy Liquid at High Density

1. Increasing the density of LST Heavy Liquid

LST Heavy Liquid is a solution of lithium heteropolytungstates in water. The material as sold, i.e. SG 2.85, contains less than 20% water by weight.

To increase the density of LST Heavy Liquid, it is necessary to evaporate or boil off some of the water. The easiest and fastest way to do this is to heat the LST Heavy Liquid in a magnetically stirred beaker on a thermostatted hotplate. When doing this, it is very useful to direct an air stream over the LST heavy liquid surface to increase the rate of evaporation. The air stream will cause some surface cooling and crystallisation, but this will usually redissolve when the air stream is removed.

If the density is above 2.95 g/mL after evaporating the water, the LST Heavy Liquid will crystallise unless held above 25 °C. The liquid must be at a temperature above its freezing point for a particular density. Figure 1 below shows the *minimum* temperatures required for different density solutions. Temperatures above this will not increase the density of LST Heavy Liquid. Lower temperatures will result in crystallisation.

If the liquid does cool and LST Heavy Liquid crystallises, reconstituting the liquid is simply a matter of warming the crystals to redissolve them. The crystals can be collected and redissolved in hot water, or heated up with a little water to form more heavy liquid.

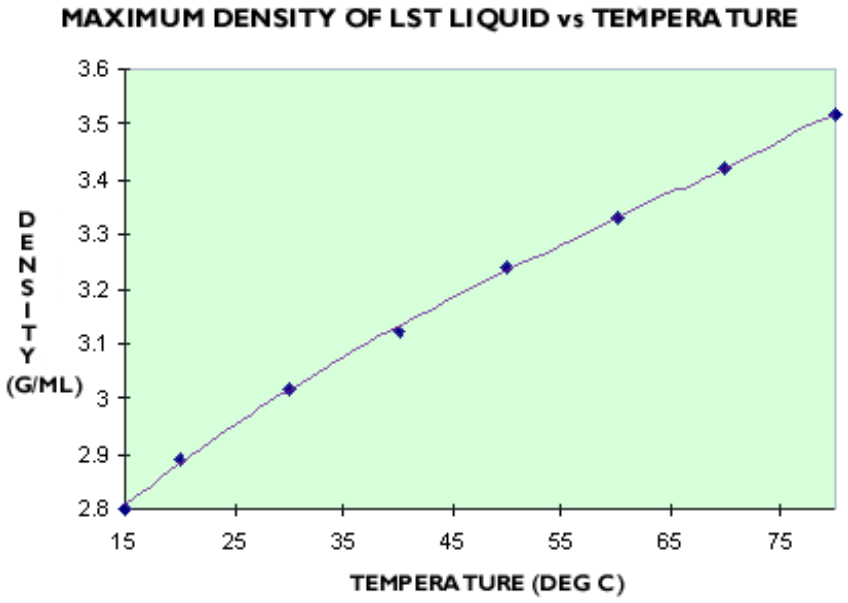

Figure 1: Maximum density (freezing temperature) of LST Heavy Liquid

2. Storing LST Heavy Liquid to use at high density

Once the LST Heavy Liquid has been sufficiently evaporated and the required density has been obtained, it is best to pour the hot dense liquid into a sturdy polyethylene or polypropylene container with a semi-sealed lid to allow pressure equalisation - e.g. a plastic screw-on cap with a pin hole in it. This container of hot dense liquid should then be immediately placed in an incubator or oven kept at a temperature a little above the freezing point for LST Heavy Liquid at that density.

If it is necessary to allow the liquid to cool, for example in intervals between heavy liquid separations, then store it in the same bottle. The liquid will solidify in the bottle when cooled, but will be able to be used when heated up again. To reuse this liquid, place in an oven at 80-85 ^{o}C overnight, which should give the crystals time to melt/dissolve and form the extra dense heavy liquid.

3. Measuring the density of LST Heavy Liquid

There are several possible methods:

accurately weighing a known volume, e.g. using a dispensing pipette,

1. measuring with a hydrometer which reads at high densities,

2. observing the buoyancy of density beads or a known mineral.

Another method to obtain solutions of approximately known density is by allowing a hot, saturated LST Heavy Liquid solution to cool down. As the solution cools some crystallisation will occur, giving a density which is directly related to the temperature. The density - temperature relationship given in Figure 1 can be used to determine the density for any given temperature as it cools, providing that the solution is saturated at the higher temperature. When the required temperature is reached, the solution of correct density can be decanted from the crystals and used. Once the crystals have been removed, the solution can be raised above this minimum temperature without changing the density.

For example, if a solution of density 3.30 were required, the temperature-density curve in Figure 1 shows that the solution should be cooled to 58 °C. Cooling the solution to this temperature and decanting from the crystallised solids will give a solution of the correct density.

4. Density separations

High density separations can be carried out in a thermostatted water-jacketed separating funnel. Alternatively, you could use some other convenient container held in a thermostatted water bath. The following procedure has been found to be useful:

(i) Obtain LST heavy liquid at the required density. This will be at an appropriate elevated temperature, as described in sections 1 to 3.

(ii) Set a thermostatted water bath to approximately 10 degrees above the minimum temperature required for the density being used. For example, if the LST Heavy Liquid crystallises at 55°C, then set the bath temperature to 65°C. This can be used as a source of constant temperature hot water for the separation.

(iii) Place the hot heavy liquid in a separating vessel which is thermostatted at about 10 degrees above the heavy liquid crystallisation temperature. For example, a hot water-jacketed separating funnel could be used. If a mini hydrometer is available, the density of the liquid in the separating vessel could be re-checked, then the hydrometer removed.

(iv) Place the mineral grains in the hot liquid, agitate a little, then allow to settle. The settling time will depend on the grain size and grain density.

(v) If using a jacketed separating funnel, turn the tap to run off the lower portion of liquid and the "sink" fraction of the grains. If the grains are coarse enough, a plastic (polypropylene) mesh can be placed in a small funnel immediately under the tap, collecting the grains and letting the dense liquid pass through into a beaker. If the use of a mesh is not practical, collect the grains and liquid in a pre-warmed beaker, then quickly add a *small* amount of hot deionised water to prevent crystallisation as the liquid cools.

(vi) The grains in the "float" fraction can be treated in a similar fashion to the "sink" fraction and collected in a fine mesh, or otherwise just run off into a warm beaker with a little hot deionised water.

(vii) Once separated, the grains should be washed well to remove LST Heavy Liquid (3 x portions of deionised water), then dried.

Notes

It is advisable to minimise the amount of water used for washing the minerals so there is less water to evaporate off when recycling the washings.

Before it crystallises, any heavy liquid which is clean and at full strength should be transferred into a polypropylene bottle for later use.

5. Recycling and recovery of LST Heavy Liquid

For dilute deioinised water washings the recycling procedure is the same as for using LST Heavy Liquid at room temperature: (i) retain the deionised water washings, (ii) filter and combine the resulting clean washings, and (iii) evaporate the washings at 100-110 ^{o}C until the full strength LST Heavy Liquid is restored.

To store any high density liquid which was either not used or was obtained from the separation in a clean state, place it in a sturdy polypropylene bottle as described in section 2.

To obtain high density heavy liquid from LST heavy liquid which has been allowed to cool and crystallise, place the LST in its polypropylene container in an oven at 85-90^{o}C overnight. You will need to allow a small “pressure release” opening in the cap when doing this, to prevent the bottle expanding under pressure.