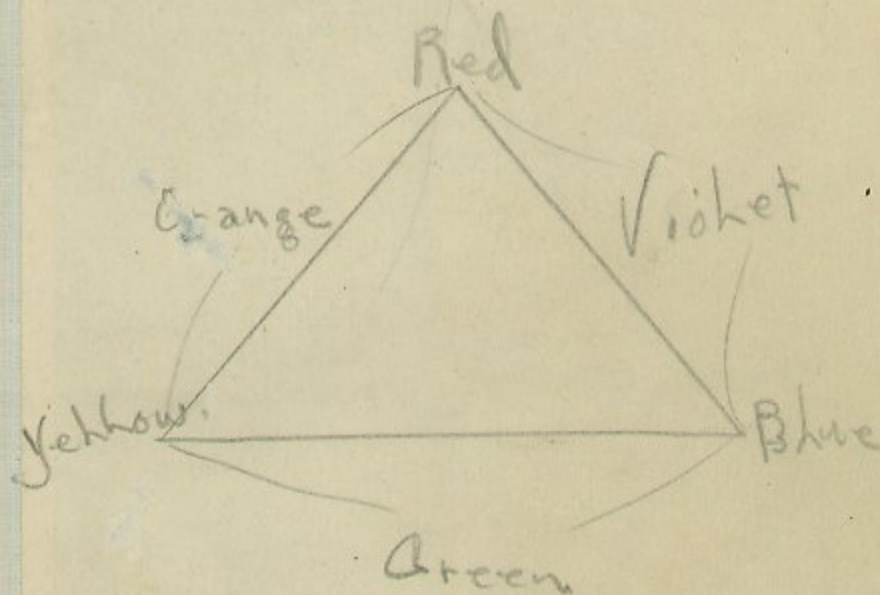


Chart Of Colors.

Violet/ --- Red --- / Orange
Blue --- Yellow.
--- Green ---



To Dissolve Gold
One part Nitric Acid
Three " Muriatic Acid
or Hydrochloric "

Soda ash should not be
over 37 lbs to the 100 of sand
Lime should not be
over 10 lbs to the 100 of sand.

Annealing--

High critical point where glass anneals in few seconds, and slow gradual cooling down to low critical range, about 500 degrees F.

Chemicals--

Pure and low in IRON.

Chords-----

Generally from pot or from cold glass, also, from poor mixing.

Mix-----

Use pure chemicals.

Mix Thoroughly.

Have no lumps.

Lime-----

Burned lime takes up water and carbon dioxide and deteriorates. Should have two bens. Use all lime out of one before using the other.

Cullet-----

Do not crush too fine, about $\frac{1}{4}$ to $1\frac{1}{4}$ inches seems to give the best results. Use same amount in different batches.

Calculations----

Glasses to be used together should have same coefficient of expansion.

Pink Glasses ----

Get darker when stirred with a wooden stick.

-----Over-----

Silica /
 Boric Acid / Acids in-glass.
 Phosphates /

Soda / Alkalis /
 Potash // Alkalis--R2O.
 Lithia //

Calcium Oxide /
 Magnesium Oxide /
 Lead Oxide // Bases--RO.
 Zinc Oxide //
 Barium Oxide //

Alumina /
 Iron / // Bases--R2O3-

*1 parts Silica
 1 parts Lime
 1 parts Soda*

R2O--- One molecule of soda.
 RO---- " " " Lime.
 6 SiO2--Six " " Silica.

12 % Na2O .
 13 % CAO. For a bat ch
 75 % SiO2.

 HIGH EXPANSION-----LOW EXPANSION-----

Soda-Soluble.	Silica.
Potash- Soluble.	Boric acid.
Lead- Less " .	Zinc Oxide.
Lime - Least Soluble.	Magnesia.

Boro silicate glasses are least
 soluble.

Nitre-- Helps melting, and oxidizes.
 Arsenic -- is a clarifier, and, part
 remains in the glass.
 Antimony-- It plains.

 Decolourizer---
 Manganese -- Selenium.

Three

1- Devitrification-
Stony metal. Not mixed well. Too low in temperature of founding, or attack on refractories.

Atoms-Molecules-(Compounds).

(One or more elements or atoms)

2- Classes - Elements & Compounds.

Any one atom may combine with from 1 to 8 other atoms, not any more.

A hydrogen atom can combine with but one atom. An oxygen atom may combine with two hydrogen atoms, and a carbon atom with four.

Combining power of an atom is called VALENCY.

Hydrogen - mono-valent, oxygen -di-valent and carbon is tetra-valent.

Hydrogen molecule is - H-H or H_2

Oxygen molecule also contains two atoms of element-O-O Or O_2

A molecule of water = One atom of oxygen bound to two atom of hydrogen equals-H-O-H or H_2O .

-O

Silicon dioxide or silica-Si or SiO_2

-O

Iron-(Fe)- It may be-divalent when it forms ferrous compounds and tri-valent when it forms ferric compounds.

The formula for ferrous oxide is (Fe) and of ferrous chloride Fe-Cl

Cl or $FeCl_2$

(Sence chlorine is mono-valent in this case)

Fe-O
-O or
Fe-O

Ferric oxide has the formula

Fe_2O_3 and ferric Chloride Fe-Cl

-Cl or $FeCl_3$
-Cl

Manganese (Mn) has a much greater variation of valency..Devalent(MnO)
Tri-valent (Mn_2O_3) Tetra-valent (MnO_2)
Hexa-valent (MnO_3) and Hepta-valent (Mn_2O_7)

Four

IMPORTANT####

(1) Soda glasses are as a rule harder than Potash glasses containing an equal volume of silica.

(2) For pure soda lime glasses, hardness increases with increase of lime and decrease of soda.

(3) Boric oxide gives great hardness to glass.

(4) Lead glasses are increased in hardness by addition of soda and of lime.

- A- Essential glass forming substances
- B- Fluxes.
- C- Oxidizing agents.
- D- Fining agents.
- E- Reducing agents.
- F- Coloring agents.

(Boric Acid- B_2O_3)

Takes place of silica in some glasses.

(Phosphoric acid & Arsenious acid)

(P_2O_5)

(As_2O_3)

Bone Ash

Calcium phosphate.

Opacifier.

Arsenious

oxide.

Clarifier.

Bases- Alkalies.

The alkalis employed in bottle, window, plate and lime flint glasses is sodium, while in the case of lead flint it is potassium.

Sodium glass melts more clear quicker than Potash glass.

(Sodium oxide, Na_2O)

Sodium carbonate is soda ash.

Sodium sulphate is salt cake.

Sodium chloride or sodium nitrate are used in small quantities but not to produce alkalies.

Cryolite as a opacifier, contains sodium as does borax.

(Potassium Oxide, K_2O)

Used in place of sodium in the manufacture of lead flint glass. Greater brilliancy & smoothness than the glass then sodium.

Potash melts slower than sodium glass.

Potash most expensive and is used in more expensive glass. ---

(Lithium oxide.)

Used for fine optical glass, very rare.

(Lime)

Gives smoothness & brilliancy to glass, also increases its power of resistance to chemical agents.

Hard & brittle. Must be annealed more carefully. 12.83 % glass becomes too hard and brittle. When it gets above 13.2 % it decreases in these properties.

Increase in lime increases the fusibility of glass up to a certain point. Prevents the formation of cords. It also increases tendency to devitrify.

Lime is introduced in glass as flourite - a calcium fluoride or bone ash which consists of calcium phosphate, are used to produce translucent opal, and opaque white glasses.

(MgO . Magnesia)

Only used in special glasses when the properties it confers are of special value.

(Barium oxide BaO)

Barium glass has greater brilliancy than lime glass. Resembles a lead glass. In hardness and coefficient of expansion it is practically the same as lead glass. Barium glasses can be melted in open pots or tanks.

Barium cannot be used in lead glasses.

" " " polished like lead by

Hydrofluoric acid.

(Zinc Oxide ZnO)

Have high tenacity & compressive strength resistant to chemical decomposition. High fluidity & low coefficient of expansion. Devitrifies readily. Large amounts of zinc in glass remains in suspension or separates out on cooling, causing the glass to become opaque. Added in the form of (over)

white oxide of zinc.

(Lead Oxide PbO)

red lead.

Increases the specific gravity or density of glasses and gives a high refractive index. Are resistant to chemical action and do not devitrify readily.

(Added to batch as

Minium or red lead.)

(Litharge Pb_3O_4)
(PbO)

(Alumina Al_2O_3)

Hard to melt and hard to dissolve

-One-

Defects: Small white spherical stones with a 'tail' of STRIAC.

Identification †

Examination under microscope showed each stone to be surrounded by a distinct ring of glass differing in appearance from the bulk of the glass. This indicated silica batch stones.

Cause †

The sand used contained large grains. Confirmed this by sifting a sample.

Remedy †

Increased temperature and time of founding.

Prevention †

Used only screened sand, rejecting large grains, and made more careful batch mixing.

{END}

Defects †

Small white spherical stones each with a 'TAIL' of STRIAC.

Identification †

Examination under microscope indicated silica batch stones.

Cause †

Since the sand in this melt had been screened, the defect could not be due to unmelted grains of sand. Sieved other materials. To provide calcium oxide in the glass ground chalk had been used. Found this contained small flinty particles slightly larger than pin head size.

Remedy †

Increased temperature and time of founding. Only partially successful laddled most of metal.

Prevention †

Used ground lime in batch instead of ground chalk.

-3-

- Three--

Defects:-

Small white irregularly shaped stones varying in size.

Identification:-

Unlikely to be batch stones as materials were all sieved, microscope examination showed stones to be full of a network of needle like crystals. These were probably sellimanite or mullite and indicated
(POT STONES)

Cause:-

Holing of pot.

Remedy:-

Lowered temperature of melting
Added an increased proportion of cullet to later fillings in order to lesson corrosion.
Trouble gradually became worse and therefore new pot had to be set.

-4-

- Four--

Defect:-

Sudden appearance of white lumps near surface of metal. The glass could be gathered quite free from stones but upon blowing, white lumps and streaks developed in the bottles, particularly in the neck.

Identification:-

Probably a separation of silica. (Devitrification) Analysed the glass and found it to contain 76 % of silica, 6.5 % calcium oxide, 16 % sodium oxide.

Cause:-

The silica contents of the glass was in excess.

Remedy:-

Ladled top portion of melt and added a batch containing a higher proportion of lime and less silica (see below)

Prevention:-

Altered batch, using one higher in lime, lower in silica and containing a little felspar. The batch analysed 72 % silica, 11 % calcium oxide, 15% alkaline oxides, 2 % alumina. At the same time reduced the proportion of a cullet at each filling on of a mixing

Defects in glass.

by

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