HAND OUT

Branch- CERAMICS ENGINEERING

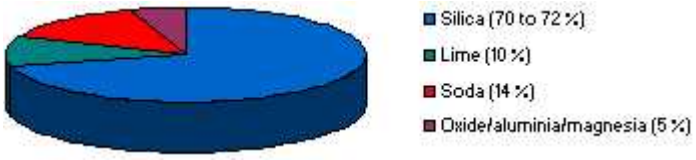
Faculty:- NIRAJ KUMAR SINGH, Lecturer, G. P. JHAJJAR

GLASS TECHNOLOGY - I

Introduction of Glass:-

Glass is the name given to all amorphous bodies that are obtained by lowering the temperature of a melt independently of its chemical composition and the temperature range of solidification, which as a result of the gradual increase of viscosity adopts the mechanical properties of a solid body. Glass is melted at a temperature between 1000 and 2000° C.
The microscopic structure of glass is comparable to that of a liquid in which the individual constituents form an irregular network without a long range order. Glass is also the name given to a cooled melt.

Raw Materials:



The substances are introduced in the form of quartz sand, soda and lime. 5% oxides such as magnesium and aluminium oxide are added to this mixture. These additives improve the physical and chemical properties of the glass.

Main glass groups	Soda lime glass
	Lead glass
	Boro silicate glass
Main glass products:	Flat glass (for architectural or automotive applications)
	Glass containers/glass tubes
	Special glasses
	Glass fibre

Origin of Glass

Naturally occurring glass, especially the volcanic glass obsidian, has been used by many Stone Age societies across the globe for the production of sharp cutting tools and, due to its limited source areas, was extensively traded. But in general, archaeological evidence suggests that the first true glass was made in coastal north Syria, Mesopotamia or ancient Egypt. Because of Egypt's favorable environment for preservation, the majority of well-studied early glass is found there, although some of this is likely to have been imported. The earliest known glass objects, of the mid third millennium BC, were beads, perhaps initially created as accidental by-products of metal-working (slags) or during the production of faience, a pre-glass vitreous material made by a process similar to glazing.

During the Late Bronze Age in Egypt (e.g., the Ahhotep "Treasure") and Western Asia there was a rapid growth in glass-making technology. Archaeological finds from this period include colored glass ingots, vessels (often colored and shaped in imitation of highly prized hardstone carvings in semi-precious stones) and the ubiquitous beads. The alkali of Syrian and Egyptian glass was soda ash, sodium carbonate, which can be extracted from the ashes of many plants, notably halophile seashore plants: (see saltwort). The earliest vessels were 'core-formed', produced by winding a ductile rope of glass round a shaped core of sand and clay over a metal rod, then fusing it with repeated reheatings.

Threads of thin glass of different colors made with admixtures of oxides were subsequently wound around these to create patterns, which could be drawn into festoons by using metal raking tools. The vessel would then be rolled smooth ('marvered') on a slab in order to press the decorative threads into its body. Handles and feet were applied separately. The rod was subsequently allowed to cool as the glass slowly annealed and was eventually removed from the center of the vessel, after which the core material was scraped out. Glass shapes for inlays were also often created in moulds. Much early glass production, however, relied on grinding techniques borrowed from stone working. This meant that the glass was ground and carved in a cold state.

Vessels were made then around 1500 BC with the help of sand core technique hollow wares were developed. After some time coloured glasses were developed. By additions copper or cabalt compounds to glass compositions blue tints were yielded.

The glass blowing pipe was developed in Syria in around 200 Bc. This tool was made from aniron tube about 100 to 150 cm long and opening of km in diameter. It has insulated handle with mouthpiece at one end and button like extension at other end.This pipe was used to collect malton glass and blow it into hollow body.

a) **Glass in period of Roman's :-** In around AD100 with the help of manganese oxide into The glass composition and improved furnace colourless glass was made.

1 **Fundamental concept of Glass state :-** Glass expresses two concept it describe state of matter and also it is the name of a commercial product . The glassy State or vitreous substance represent district state of matter .These materials are included in amorphous material. Amorphous materials which lacks crystal structure. This means those materials in which atoms or molecules are arranged in random. When a liquid consisting of pure compound . above its melting point is cooled , crystallisation should began to occur when the temperature specific for each compound is reached . As the liquid solidifies, heat is given out and maintain the mass at a fixed temperature is until all is solidified. The temperature is called freezing point and corresponds to the temperature at which solid melts . After cooling and solidification these compounds have geometric structure and propeties as that of crystals. So above process is characterstic property of crystalling solids in which atoms Or molecules are arranged in regular pattern. Certain liquids when cooled behave in a different manner as describe above . These liquids on cooling become more and more viscous, passing gradually into a rigid condition. When this rigid solid is again heated it gradually softens and becomes Less and less viscous liquid.Such a liquid which solidifies on cooling without crystallisation is called glass, regardless of its chemical composition .

When the glass is heated or cooled , these shows a typical behaviour. When a glass is heated a glass softens and gradually acquire more and more fluidity. The reverse occurs when the viscous glassy liquid is cooled and rigid elastic condition is reached without any sudden change. The glasses do not have heat of fusion (latent heat) , where as crystals have in crystals during heating sudden absorption of heat without rise of temperature when the melting point

Is reached and during cooling a sudden evolution of heat take place without any change of temperature , when freezing point is reached.

Glasses do not have melting point they have softening temperature. When glass is heated softening of glass is gradual and continuous process. The Rigidity or elasticity is not lost at some definite temperature . At temperature that elasticity and fluidity are both present. This range of temperature is called the “elastico-visco-region”. For common glass this temp. range is 400 to 500.c

When glasses break , the character of fracture can not be predicted whereas crystalline materials show definite cleavage planes related to its geometrical structure.

Glasses are not stable at elevated temperatures. If maintained for a long

Time above its softening point, almost any vitreous substance will crystallize or devitrify . the formation of glass depends on rate of cooling. It cooled very slowly all liquids crystallises , on the other hand if rapid cooling is carried out many substances which normally crystallise may be obtained in vitreous condition.

Definition of Glass :-

Glass is an inorganic product of fusion (melting) which cooled to a rigid condition without crystallisation . it is defined as or frozen super cooled liquid.

The term glass has various meaning it describe state of substance (vitreous0 or a material (window glass) or an object e.g wine glass

Charactertics of Glass :-

(1) Glass is typically hard and brittle and has conchoidal fracture. It may be colourless or colourd and transparent or opaque by the presence of dissolved amorphous or crystalline material.

(2) specific kind of glass is indicated its description is written before term glass

Such as flint glass, barium glass or window glass

(3) Objects made of glass are loosely and popularly referred as glass such as

Glass for a tumbler, a barometer, a window etc.

1.3 Component of Glass :-

Glass are made up of oxides. The composition of glass is found by

Quantitative chemical analysis. In this method definite compounds of each

Element present (expert oxygen) are made by chemical reaction. Then these

Compounds are separated in a pure condition and weighingsit or causing it to

React with a measured quantity of some re-agent. This can also be done by physical method. (x-ray' technique)

After analysing the glass and the constituent elements are calculated to oxide equivalents it is found that sum of weight of oxide is equal to weight of sample taken

With in experimental errors This show that component of glass are oxides. These are few exceptions . the alabaster and opal glass contain fluorides and small amount of chlories and certain elements presents in uncombined state act as colourants.

1.4 Classification of glass making oxides :-

(a) Based on structure of glass

(1) network former

(2) network modifiers

(3) intermediate

(b) Based on chemical nature

(1) acidic oxide

(2) basic oxide

(3) Amphoteric

(A) Based on structure of Glass

(1) Network former :- These are those elements whose atoms are of suitable size to be surrounded

By four oxygen atoms each in tetrahedrad arrangement these elements realily

Forms chains and network that may exist in completely random fashion and

Produce glasses by themselves oxides of such elements are called network

Former network

Glass or network formers oxide readily from glass when cooled from molten

Glass. Silica boric oxide (b2o3) . phosphorus pentoxide (p2o5) arsenious oxide

(As203) and germanium oxide (geo2)

Non – oxide formers are arsenious sulphide (a5s3) berilium fluoride (Bef2), Zinc chloride(zncl2)

2.) Network Modifiers :- The elements whose alone are of larger size and have higher

Co-ordination so that it must be surrounded by more than four atoms are known as

Network modifiers .These elements cannot form glass by them selvos. Sodium , Calcium and Barium are network modifiers.

(2) Intermediates:- These elements are those which cannot form glass by themselves, but if fused with network formers, these elements may take the co-ordination no of letter and play role like network formers such oxide are called intermediation Al2o3 is an intermediate

In genral the network formers are acidic oxides , modifiers are bases and intermediates are amphoteric

(B) Based on chemical nature

(1) Acidic oxide

(2) Basic oxide

(3) Amphotoric

C.9 Glass making oxide and their properties

Acidic oxides :-

Silica :- chemical name =silicon diaoxide

Chemical formula = Sio2

Molecular weight 60.1

Melting point= 1713

Silica is major oxide which acts as a glass, former and is acidic in nature . silica is very

Abundant and makes up 59% of the weight of earth's crust . The main source of silica is

Glass and is known as fused quartz or quartz glass the silica increase viscosity and

Contributes least to thermal expansion of glass.

The common from of silica is quartz which is crystalline in nature . Tridymite

is less common from and is produced prolonged heating of silica at high temperatures At still high temp. if change into cristoballite difter in the way in

Which the tetrahedral which makes the faltica are linked together by oxygen

Silicon bonds.

(c) Boron oxide :- chemical Name =Boric oxide

Mofecular weight = 690.6

Melting point = 450.c

Chemical formula =B2o3

Boric oxide occur in nature as boric acid .(H3BO3) and borates. It is not found in free state . It is formed by heating boric acid. The oxide is viscous liquid at dull red heat . On cooling if forms glass but immediately start taking water from glass but immediately starts taking water from atmosphere.

And change back into boric acid . Boron oxide is glass former by itself it is used in low melting enamels and in combination with glass to make low – expansion borosilicate glasses.

Alumina :- chemical name= Aluminum oxide

Chemical formula =Al2o3 (x-corrandum)

Molecularwt= 102

Melting point= 2050.c

Aluminium oxide occurs in nature. As emery This is an impure corundum . This is found in

Combined from in felspars and clays. This is the second most abundance element in earth crust .

Alamina melts at 2050.c and crystallises on cooling .Small amounts of alumina present in almost all glasses, because it gets dissolver from clay and other refractories used for melting of glass.

Uniformly distributed alumina in glass ratards devitrification and improve durability

Of glass. Some amount of alumina is always added in batch of glass. In some glasses larger

Amount of alumina upto 20% are used to obtain special properties. These glasses are known

As alummosilicats.

(C) Basic oxide.

Soda Chemical name=sodium oxide

Chemical formula= Na2o

Molecular weight= 62

Soda or sodium oxide with formula Na2o is not generally available . Only a small quantities are manufactured . when sodium burns in air or oxygen sodium peroxide Na2o2 is or sodium nitrate

NaNo2 or sodium nitrate NaNO3 IS HEATED Na2o2, sodium peroxide is obtained.

Soda is network modifier .It weakens the silica network in glasses, making it more fluid

And soluble in water. It is used as principal flux in glass. In glass it is obtained from Sodium carbonate, sodium sulphate or some other sodium salts.

(b) Potash: Chemical Name = Potassium oxide

Chemical formula= K2O

Molecular weight= 94.1

When potassium burns in air to obtain potash it takes more oxygen and form Ko2(potassium super oxide), but potassium always present in compounds as kton with valance one.

Potash reacts vigorously with moisture and from potassium hydroxide (caustic potash) This oxide is unstable in most air and hence never found free in nature.

It also act as flux in glasses .It is slightly less active on weight basic and more expensive then soda . It also increases fluidiftyy expansive of glss.

(d) Lithia :-

Chimical name= Lithium oxide

Chemical formula= Li2o

Molecular weight = 29.9

Lithium when burn in dry air forms lithium monoxide9Li2o) It reacts readily with water and

Hence never found free in nature.

Lithia is more powerful flux then soda potash, for an equal persent by weight, because it has low mofecular weight. It is very expansive and used to melt difficut glasses.

(e) Lime:-

Chemical Name = Calcium oxide

Chemical formula=Cao

Mofecular weight=56

Melting point= 2520’c

Line when used with soda and silica is most important constituent of soda-lime glass. It is network

Modifier and actas flux. At high temperature weaken the glass network and increase the fluidity of

Melt. At low temperature the double charge of calcium on pulls the glass network together and make glass more right. Hence is the attack of water is reduced. It line is present in excess amount it

Devitrify the glass it has highest density than principal glass forming oxides (silica , boron oxide and Alumma), due to this glasses which have high line contant are denser than those which have high silica.

(f) Magnesia:

Chemical Name = Magnesium oxide

Chemical formula = MgO

Mof.weight = 40

Melting point = 2800’c

It is weaker base than. Line and hence isles) reactive. It acts as a network modifier. It has almost same properties as that of line.

(1) Lead oxide :-

Chemical formula = Pbo

Nume = Leadoxide. .

Mof.wt= 21.3

Melting point= 888’c

Litharge the raw material I lead oxide is pale yellow powder when heated in air above its

Melting point. This is the only gl;ass forming melting point. This is the only glass

Forming oxide which is coloured. It lead is present in small amount glass format is colouredless . It large amount is present pale yellow tint is produced in glass.

It acts as network modifier . but when it present more than 2 moles of lead oxide to one mole of silica , it may be cooled to glassy state without crystallisation . In this composition lead con forms the links between silicon oxygen tetrahedral, hence it may

Regarded as network inter mediate. It acts as a flux in glass and it increases the density of glass.

(3) Borium oxide :-

Chemical name =Baryta

Formula = Bao

M.W. = 153.'

Melting point = 1923.c

Barium oxide can be obtained by heating barium nitrate, but it can not be used in cemmerical

Because it converts to BaO2 on heating in air. At high temperature barium peroxide decomposes and give oxygen . Barium oxide has melting point of 1923'c It is not stable in

Ordinary air. It form first hydroxide and then the carbonate.

(h) Strontium oxide .

Formula = SrO

M.W= 103.C

Strontium Oxide. Is a modifying oxide having properties intermediate in glass , network between line and barium oxide. It is used in face plates for colour television tubes because strontium atoms are efficient in abborbing soft x-ray, generated in such tubes

(i) Zinc oxide is obtained by heating zinc in air . it becomes yellow when heated and turn again white in the cold condition . It reducing agent , like carbon are added in glass than zinc oxide

will reduce to zinc metal and it will escape (boiling point 907'c it acts as modifier in glass. It is particulary

Valuable in colured glasses containing sulphur and selenium because it will help to retain these vartile elements in glass. In wet reaction zinc oxide has amphoteric character.

1.5 The Functions of Glass making oxide:-

The oxides in glass making have different functions. The silica is most important and act as

Added to reduce high viscosity of silica. The R.O. bases (cao,mgo,zno, Pbo, Bao) typically

Line. The action of water . The relation ship of silica, Robers and other oxide is shown

Below in fig.

To show the function of oxide three lines are drawn at 120' degree to each

Other. Toward the lower right is the line indicates the effect of silica . Due to silica the

Molten glass have high viscority and cold glass has vitreous character. Silica contributes least to the therm

Fig .

Expansion of glass.

Towards left , line shown effect of soda. Soda increase the fluidity of glass and

Expansion of glass. Due to this oxide the water have high attack on glass. The soda

Increase the solubility of glass.

In the third direction the effect of line is shown . it provide durability of glass

Against the attacks of water . It also increase devitrification tendency of glass. Or the

Tendency of glass to crystallise out of vitreous condition. The potash have also some

Effect as that of soda . It is less powerful flux and hence its line is dwawn towards right

Of soda .the Lithia also have some effect as that of soda .It is more powerful than soda .

Boric oxide is given position between soda , and silica. At high temperature its glass

Melt is viscous and hence borates exits in glassy state. Also addition of small amount of

Boron oxide reduces the expansion of glasses.

Alumina is placed between line and silica, because it increase the viscosity of Molten glass and increase the durability of glass . Howerer it retard devitrification . So two o'clock line best expresses its behaviour magnesia is shown beside line in Almost same direction 'as' it has some properties as that I line . Zinc oxide increase The durability of glass.Also it increase the visocisty of glass, but more than line. So It is placed right to line. Lead oxide increase the density of glass . also it has some Fluxing the density of glass also it has some fluxing power and promotes fluidity . It helps in easy working of glass. It also increase the durability of glass. So it is flaced Between soda line . The barium oxide have behaviour in between as that of line And lead oxide , so it is placed between them.

The above said scheme is very simple as effect of oxides are not clear cut and Oxides cannot be easily differentiated from each other in their influence on behaviour

And properties I glass. But this given very good idea in one look about their functions.

1.6 Accessory oxides and other constituent of glass:

The are many other oxides which are added in glass in very small Amount to give particular properties. Also some oxides are present as impurities in Raw material . These oxides are called accessory oxides. Some oxides are added to Dissolved gases such as oxygen.

Beryllia is added to product some typical properties . of glass and is substituted for line. But it is Used very rarely because it has toxic, but it is too costly to true glass former, but it is too Costly to be used. Columbia(niobium oxide , Nb2o5) and tantalum pertaxide (Ta2o5) are glass

Formers and these are used to make optical glasses of high index.

Noble metal, sulphides and selenides are added as colouring oxides. Fluorides,

Phosphates, tin oxides and other opacifying material are used in making opal glass.

Arsennic oxides, antimony oxides, sulphates and chlorides are added to remove bubbles from

Glass. These are called fining agent

1.7 Raw material of glasss :-

(a) Raw material of silica

(a) Sand: Sand is used as rawmaterial of silica In quartz from . the sand grains should

Not pass 20 mesh-screen. It sand is to be used for optical glasses the iron contain

Should not be greater than .0.04% it also contain traces of line , magnesia, titania and other oxides. Dry sand contains about 99.7% of silica. Sand is most important raw material of glass. Almost half the surface of earth contain silica. The sand is obtained from

Earth after chemical and physical purification.

(b) Other raw material :-

The other raw materials from which silica is obtained include feldshar,

Kyanite (Al2o3.sio2) , Kaolin(Al2o3. 25,02. 2h2o)

(c) Raw material of Alumina:-

(a) Feldshar: Feldspar is most abundant rock farming mineral having general formula R2o. Al2o3. 6sio2. Where R is alkali, it may be potassium(k) or sodium(Na) when R is

Potassium feldspar is known as microlink or orthoclase feldspar when R is sodium,it is known as albite. Another type of feldspar is known as line feldspar . Its mineralogical name is anothite Its formula is

2.CaO.2Al2o3..6SIo2.

The feldspar occur as granite rock mixed with quartz, mica and other minerals. Large

Grains of feldspar should not be used in glass batces. Although mineral is readily metted

But large grains I feldspar takes long time to diffuse and mix . The larger grains of feldspar may produce glassy ‘knots’ intubing and lead glasses.

(b) Alumina Hydrate : Its theoretical formula is At (oh)2 or Al2o3.3H2o. It contains 65% of alumina. It is raw material of alumina and is made by precipitation process from bauxite.

(c) Aluminum oxide (Al2o3):

It is also known as ealcined alumina. Its chemical formula, Al2o3. It is produced by heating the hydrate to approximately 100’ c to drive of water . it is morebb expensive

Than feldspar , which have soda and silica . it is used where low alkali, content is required

Such as bore silicacate glass . In borosilicate glasses if alumina is used than borex can be used instead of borix acid. Boric acid is very expensive.

(d) Nepheline syenite :

It is quarried as rock and than grand . it contains approximately 23%

Alumina , 11% soda and 4% potash.

(e) Aplite:- Aplite is rock consisting of mixed feldspare . It contain 23% alumina and

60% silica together with alkalies and line

(f) Kyanite: It is mineral having therotical formula Al2o3.sio2. It is added as source of alumina in refractories and in glasses of alkali contain.

(g) Kaolin : It is also known as china clay having theoretical formula Al2o3. 25,o2.

2h2o. it contains maximum of 39.5% alumina. It has high contain of high iron contain.

(h) Slags: It is by product of metalluragg. And used as sources of alumina , line and silica.

(d) Raw materials of boron oxide:-

(a) Borax: Its chemical name is sodium tetraborate decahydrate. Its chemical formula is

Na2B4o7. 10H2O. or Na2o.2B2o310H2o. It is one of the purest raw material.

It slowly looses water and after long starage it contain less water than the Proportion in above formula . Borex is supplied in powdered or granular from. When Heated it swell (more volume) as it loses water. Then it melted down at low red Heat to clear glass. It is cheaper per unit weight of B2o3 and in addition it also Supplies Na2o. It contain 36.6% B2o3 and 16.3% Na2o.

(b) **Razorite**: -

It is mineral of boron and have similar compositionas that of borex . but have less Water . it have high iron content , so it is used in glasses where colour is not important .

© **Dehydrated Borax :-**

It is produced by crystallinzin Na2B4o7% Na2o. it is also known as Pyrobor. The elimination of water saves freight charge.

(e) Boric Acid :-

It is also known as boraic acid . its formula is H3BO3. It is produced from Borax and other borates by treateing with strong acid such as hydrochloric or Sulphuric acid. The boric acid is volatile and looses small boric acid from melts . Soda . also evaporates if melt contain 56..4% B2o3.

D Raw materials of sodium :-

(a) Soda ash :-

It is also known as sodium carbonate Na2co3. it is made from common Salt (Nal) by solvag process. Soda ash is excellent raw material for process. Soda . The main impuritity in soda ash is sodium chloride. Which 0.5% the Soda (Na2o) present in soda ash is 58.5%.

(b) Sodium hydroxide or caustic soda:- (Naoh)

This raw material is used as a raw material for soda-lime glass in container industry. It is supplied in concentrated solution.

(c) Sodium chloride (Nalt) :-

It is used in small amount in hard borosilieate batches as a refining agents.

During melting half salt is lost by evaporation and remaining half salt reacts with

Water from furnace gases or raw material to from soda .

2Nacl+ h2o—Na2o + 2HCF

The hcf formed is carried away by flue gases. And sodium oxides enters into glass

Composition.

(d) Sodium bicarbonate Nahco3 :

It is also known as baking soda .the soda obtained from sodium

Bicarbonate is very pure . it contain 36.9% of soda . it is more expensive.

(e) Slt cake or sodium sulphate:-

Its chemical formula is Na2so4. It is produced as a by product during

Making of hydrochloric acid it has 43% of soda . sodium sulphate does not react

With silica below 1500'c . so in glasses where sodium sulphates are used some carbon

Is added which reduces the sodium sulphates to sodium sulphites, which reads with silica

At low temperature ..

The sodium sulphates which is not reduced to sulphate rises to the surface of glass melt as an immiscible liquid lager known as "salt water " or "glass gall" here it is slowely reduced to sulphate by direct contact with the flame of furnace or slowely react with silica at high temperatures at the surface of glass . melt. So it helps in dissolving unmelted silica which escaped from solution of melt at surface . this unmetted silica if not dissolved would remain as a floating scum . so small amount of salt cake also hepin removed of fine bubbles from malten glass.

(f) Sodium Nitrate :-

It is also known as chik saltpaper or soda niter. Its formula is nano3 it has the lowest melting point of all glass making material, so it is used to accelerate melting at low temperatures . Also it provide soda to glass melt used as oxidising agent . sodium nitrate

Contain 36.4% na2o

(g) Glass maker's potash :-

It is also known as potassium carbonate . it is available in two commerical forms. These are (1) hydrated carbonate k2co3.1.5 h2o (2) calcined potash k2co3

The hydrated corbonate is a crystalline material and is always damp because itcontain chemically combined water . calained potash takes up water quite rapidly in humid airand form hydrate and forms lumps or cake on long storage.

(h) Saltpeter:-

It is also known as niter or potassium nitrate KNO3 it is made from sodium nitrate by double decomposition with potassium chloride . In melting process it serves as starting

Flux and an oxidising agent.

(f) Raw materials of lime:

(a) Limestone : it is rock which consist of calcite Caco3. it is widely distributed and in varying degree of purity . its varities are from marble to calcareous earth or marks. Some sources of lime stone also have dolomite (Caco3.Mg co3) or a mixture of dolomite and calcite.

To lower the trans portation cost burnt line is used . limestone is preferred for the high lime glasses used in plate and winwod glass. Burnt lime generally used for hollow ware a

Good limestone contains less than 0.1% fe2o3 from 0.3% to 0.6% acid insoluble mineral and 0.2% to 0.4% Al2o3. It is mainly calcite and have maximum of 56% cao. In dolomite,

Limestone there is 30% cao and 21-5% mgo.

(b) Burnt lime:

It is also known as quick line. Obtained by , its formula is cao . it is obtained by

Burning dolomite its formula is cao.mgo. When it is true line(cao) it takes up atmosphere moisture rapidly and forms the hydrate . (ca(oh)2) it has about 75% cao. However burnt dolomite hydrate with less speed.

(c) Agpsum: (caso4.2h2o) . it is used inplace of salt scake . during melting , it will loose water first, then react with sodium carbonate and finally produce line and sodium sulphate

Caso4+Na2co3—Na2s4+cao+co2

(g) Raw material of magnesia:

(a) Magnesite : its formula is Mg co3. it is used a source of magneria when line is note desired . both magnesia and take gives hydrous magnesia. But these source containhigh iron content . Another source of magnesia is "sea water magnesia" which prepared by precipitating mg(oh)2 from ocean brain with cao.

(h) Raw material of other basic oxide:

(a) Litharge (pbo) it is yellow lead oxide and is many factured by spraying molten

Lead into a furnace with current of air. This is also called sublimed litharge . This is very fiely divided and very reactive . it is free from metallic lead particles but this fine

Powder land to stick to operators hand and hence there is threat of health hazard

During mixing because of its torix nature.

(b) Red –lead : it is formula is pb3o4 . it is formed by roasting litharge in air at tempr

Around 475'c.

6pbo + o2 ---2pb3o4.

But this reaction is reversible, so product available in market contain 75% true red lead and 25% litharge.

(c) Lead silicate: it is a glass made by melting litharge with sand . it contain 85%

Lead oxide and is yellow granular powder free from sticky character. And hence it is less harmful.

(d) Barium carbonate (BaCo3) it is made from barium sulphate . it contain 77%

Barium oxide this is the main raw material is introduce barium oxide.

(e) Barium sulphate (BaSO4) it is also known as heavy spar. It is ground mineral product.

(f) Barium peroxide (BaO2) it is used an oxidising agent inplace of barium nitrate. It is costly.

(g) Zinc Oxide (Zno) : it is made by oxidation of metal and than purify

(h) Arsenious oxide (As2O3). It is also known as white arsenic or glass makers arsenic. It has formula AsO3 and is produced as a by product during copper extrachion . it is 99 to 100 % pure . this is used on melting process to eliminate bubbles from melten glass and to control the coloured of iron in glass.