INDUSTRIAL PROCESSES°

Manufacture of sulphuric acid

- **Dry Sulphur dioxide** gas free from impurities is heated with dry pure **oxygen** gas at low temperatures of about 450℃ high pressure of about 1 atmosphere in the presence of vanadium(v) oxide catalyst forming Sulphur trioxide. This occurs in a **combustion cylinder.**
- Sulphur trioxide is dissolved in little **concentrated sulphuric** acid forming fuming liquid called oleum.
- Oleum is added to a regulated volume of distilled water to form 98% concentrated sulphuric acid.

SIDE EFFECTS, EXPLANATION AND MITIGATIONS

- **Hot surface burns** from combustion cylinders causing **wounds** hence pain to workers, this can be mitigated by **proper use of personal protective** equipment
- **Poisonous fumes** by waste gases which when inhaled can cause **respiratory complications**, this can be mitigated by **fitting catalytic converters** in exhaust pipes of machines
- Destruction of **vegetation/cutting down trees** for space for construction and installing machines that increases carbon dioxide in air hence **global warming**. This can be mitigated by **planting trees** that grow and mature faster.

SOCIAL BENEFIT; EFFECT AND IMPACT

- Employment opportunities; Increased income among residents hence improved standards of living
- Government gets revenue; develops infrastructure e.g. roads which facilitates trade, hence improved income thus improved standards of living.
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ETHANOL

- The starch containing substance is crushed to extract starch.
- Malt is then added to starch in a **container** and it is then covered, malt contains an enzyme diastase that catalyzes hydrolysis of starch to maltose
- Yeast is then added to maltose after about 5 days at room temperature. The maltase in yeast catalyzes the hydrolysis of maltose to glucose.
- Zymase enzyme in yeast catalyzes the breakdown of glucose to crude ethanol and carbon dioxide
- Crude ethanol is converted to pure ethanol by fractional distillation

SIDE EFFECTS, EXPLANATION AND MITIGATIONS

- **Hot surface burns** from distillation tank causing **wound** hence pain to workers, this can be mitigated by **proper use of personal protective equipment**.
- Destruction of **vegetation/cutting down trees** for space for construction and installing machines that increases carbon dioxide in air hence **global warming**. This can be mitigated by **planting trees** that grow and mature faster.

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DETERGENT(SOAPY)

- A mixture of vegetable oil and concentrated sodium hydroxide solution is boiled while stirring until no more reaction occurs in a boiler (**plastic container**).
- The resultant soap solution is cooled, concentrated sodium chloride solution is added to soap solution to precipitate out the soap.
- Soap floats and it's skimmed off. Additives like perfumes and dyes may now be added
- It is then purified by boiling it in water and re-precipitate it with brine.
- soap is baked into desired bars and it is stored

SIDE EFFECTS, EXPLANATION AND MITIGATIONS

- **Hot surface burns** during the heating process causing **wounds** hence pain to workers, this can be mitigated by **proper use of personal protective equipment**.
- Destruction of **vegetation/cutting down trees** for space for construction and installing machines that increases carbon dioxide in air hence **global warming**. This can be mitigated by **planting trees** that grow and mature faster.

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EXTRACTION OF IRON

- Coke, haematite, and limestone are fed into a **blast furnace** from the top.

  Hot air is from the bottom of the furnace Coke is oxidised by hot air to carbon dioxide.

- The carbon dioxide formed is then reduced by unreacted coke to carbon monoxide.
- The carbon monoxide reduces the hematite to molten iron and Carbon dioxide is given off
- Limestone decomposes to calcium oxide and carbon dioxide. The calcium oxide reacts with silicon dioxide which is an impurity, forming calcium silicate which is tapped off

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COPPER EXTRACTION

- **Copper pyrites** are crushed and **concentrated by froth floatation.**
- The concentrated ore is dried and roasted in **air** in a **furnace** to form copper(I) sulphide, iron(II) oxide and sulphur dioxide gas
- **Silicon dioxide** is added and reacts with iron(II) oxide to form iron(II) silicate hence iron(II) oxide is removed.
- The remaining copper(I) sulphide is then heated in controlled air supply to form **impure copper.**
- The impure copper is then **purified** by electrolysis in an **electrolytic cell** to form pure copper.

SIDE EFFECTS, EXPLANATION AND MITIGATIONS

- Destruction of **vegetation/cutting down trees** for space for construction and installing machines that increases carbon dioxide in air hence **global warming**. This can be mitigated by **planting trees** that grow and mature faster.
- **Toxic gases** like Sulphur dioxide are released to the atmosphere and cause **respiratory complications**. This can be mitigated by **fitting scrubbers in the exhaust pipes** of machines to neutralize the acidic gases.

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MANUFACTURE OF CEMENT

- A mixture of limestone and clay are crushed and milled into fine powder
- The powder is then mixed with water and allowed to flow down a **rotating cylinder** in which it is heated to a temperature of about 1500^{o}C
- Limestone decomposes to calcium oxide and carbon dioxide.
- Calcium oxide reacts with aluminum oxide and silicon dioxide in clay to form lumps of calcium aluminate and calcium silicate
- The lumps are crushed to form cement as fine powder.
- Gypsum is added during the grinding process to moderate the reaction between cement and water.
- Cement is then packed in bags for use.

SIDE EFFECTS, EXPLANATION AND MITIGATIONS

- **Toxic gases** and dust are released to the atmosphere and cause **respiratory complications**. This can be mitigated by **fitting scrubbers in the exhaust pipes** of machines to neutralize the toxic gases.
- Destruction of **vegetation/cutting down trees** for space for construction and installing machines that increases carbon dioxide in air hence **global warming**. This can be mitigated by **planting trees** that grow and mature faster.
- **Hot surface burns** from combustion process causing **wounds** hence pain to workers, this can be mitigated by **proper use of personal protective** equipment

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MANUFACTURE OF AMMONIUM NITRATE FERTILIZER

- Nitrogen from air and hydrogen from natural gas are compressed and passed over heated iron catalyst in a catalytic chamber. The two gases react to form ammonia.
- Ammonia is mixed in excess oxygen, purified and passed over platinum catalyst at 700^{0}C and ammonia is oxidized to nitrogen monoxide and water.
- The gases are cooled and mixed with more air to form nitrogen dioxide.
- Nitrogen dioxide is absorbed in hot water and excess oxygen to form nitric acid in the absorption tower.
- Nitric acid is reacted with concentrated ammonia to form ammonium nitrate.
- The product is evaporated to dryness to obtain pure ammonium nitrate.

SIDE EFFECTS, EXPLANATION AND MITIGATIONS

- **Toxic acidic gases** released to the atmosphere and cause **acidic rain that lowers pH of soil hence reduced yields**. This can be mitigated by **fitting catalytic converters** that convert nitrogen oxides to nitrogen.
- **Toxic gases** released to the atmosphere and cause **respiratory complications**. This can be mitigated by **fitting scrubbers in the exhaust pipes** of machines to neutralize the toxic gases.
- Destruction of **vegetation/cutting down trees** for space for construction and installing machines that increases carbon dioxide in air hence **global warming**. This can be mitigated by **planting trees** that grow and mature faster.

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SODIUM HYDROXIDE AND CHLORINE

- Brine is electrolyzed in an electrolytic cell having mercury cathode and graphite anode.
- During the process, chloride and the hydroxide ions move to the anode. Chloride ions are discharged and lose electrons to form chlorine gas. This is due to their high concentration. **The chlorine formed is dried liquefied and stored in tightly closed tanks.**
- Sodium and hydrogen ions move to the cathode and sodium ions are discharged. They gain electrons to form sodium metal.
- The sodium metal dissolves in mercury to form sodium amalgam which is reacted with water to form sodium hydroxide solution, hydrogen and mercury. Mercury is fed back for reuse the cathode
- The sodium hydroxide solution is evaporated to dryness to molten sodium hydroxide and cooled to form solid sodium hydroxide.

SIDE EFFECTS, EXPLANATION AND MITIGATIONS

- Mercury poisoning. Exposure to mercury inhalation can cause damage to the nervous system, kidneys, liver and immune system hence cancer. This can be mitigated by posting hazard warning information in working areas.
- **Toxic acidic gases** released to the atmosphere and cause **acidic rain that lowers pH of soil hence reduced yields**. This can be mitigated by **fitting catalytic converters** that convert nitrogen oxides to nitrogen.
- Destruction of **vegetation/cutting down trees** for space for construction and installing machines that increases carbon dioxide in

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