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Critical Evaluation of Hazards in Alpha-Blue Manufacturing Process

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Abstract *The paper summarizes the hazards in the α-Blue Manufacturing Process. The process description is presented in by taking into account the possible hazards in all the seven steps of reaction. A critical evaluation of hazards is done for storage and handling of the reactant and products. A hazard and operability study is presented. A mitigation of hazard by process modification is presented. The evaluation of hazard offers the advantage of designing the processes for better health, safety, and environment.*

***Index Terms*— Hazard, CPC Blue, alpha-blue, process modification**

I. INTRODUCTION OF ALPHA-BLUE

A pigment is a material that changes the color of reflected or transmitted light as the result of wavelength-selective absorption. This physical process differs from fluorescence, phosphorescence, and other forms of luminescence, in which a material emits light. A pigment must have a high tinting strength relative to the materials it colors. It must be stable in solid form at ambient temperatures.

Pigments are used for coloring paint, ink, plastic, fabric, cosmetics, food and other materials. Most pigments used in manufacturing and the visual arts are dry colorants, usually ground into a fine powder. This powder is added to a vehicle (or binder), a relatively neutral or colorless material that suspends the pigment and gives the paint its adhesion. In some cases, a pigment can be manufactured from a dye by precipitating a soluble dye with a metallic salt.

For industrial way we see the alpha-blue pigment , it generally made by reaction with concentrated sulfuric acid and CpC Blue (Copper Phthalocyanine Blue) at particular temperature and proper time. Here the alpha crystals so obtained are more stable than normal alpha crystals and another benefit is that this avoids the use of concentrated sulphuric acid.

Alpha-Blue Pigment Strength

Checking Alpha-Blue Powder on Muller With Standard Sample

Figure 1 Muller Test for the quality of alpha-blue produces

II. PROCESS DESCRIPTION

A. *Process*

Reaction Section

First in Ball mill add 500 kg CPC (Copper Pthalocyanine Blue) and 15kg H_2SO_4 (98% Concentration), after close the main hole of ball mill start it to rotating up to 5 to 6 hours. When CPC proper crushed in ball mill till 5 to 6 hrs , then stop the ball mill and all the slurry form with small particles are take in the GLR (Glass Line Reactor).

. Drowning Section

In GLR (Glass Line Reactor) Further add 65% Concentration H_2SO_4 quantity with 3750 kg. In GLR (Glass Line Reactor) start stirrer till all the materials are mixed, here we get all material in slurry form. Now from GLR (Glass Line Reactor) all the slurry materials are going to open tank with pump or vacuum. when all the material come in open tank then further add 5000 liter Acidic water and raw water for down the concentration.

Filtration & Washing Section

After adding water start stirrer, at that time we start to ready PF (Press Filter), checking its bag, plate should be clean. Then start the PF - 1(Press Filter), and cake deposited in the plate and ML (Mother Liquors) goes to storage tank , ML (Mother Liquors) contain 20 – 22% H_2SO_4 (10,000 kg)When after getting 5 kg pressure in PF - 1(Press Filter), start air for dry the wet cake.

Purification Section

Now take Acidic water and fresh water in open tank for dilution and add all press filter material. After further start PF- 1(Press Filter). In second filtration when we get wet material that wet material unloaded. Those wet material charged in the GLR (Glass Line Reactor), also add 4000 liter recycle and fresh water , also add caustic flaks depend on PH ,and start heating up to 90^0 Celsius. This time we see about PH it should be up to 5-6 PH.

Filtration & Washing Section

When we start heating till we see another PF- 2(Press Filter) checking its bag, plate should be clean. After heating is completed start to cool the reactor and after room temperature is getting start PF- 2(Press Filter).Then start the PF - 2(Press Filter), and cake deposited in the plate and ML (Mother Liquors) goes to storage tank, ML (Mother Liquors) contain water goes to ETP, contain 7 PH. When after getting 5 kg pressure in PF - 2(Press Filter), start air for dry the wet cake.

Drying & Packaging Section

When air drying is over then unloading the wet cake in double polythene bag, and all material take for drying.

First Check Continuous Dryer, and charged PF - 2(Press Filter) wet cake, and start drying till 6 hrs, when all material drying properly (Check sample for moisture contain) all dry material unloading in Clean double polythene bag, and send in packing section, for packing, and dispatches it.

A. ***Process Block diagram***

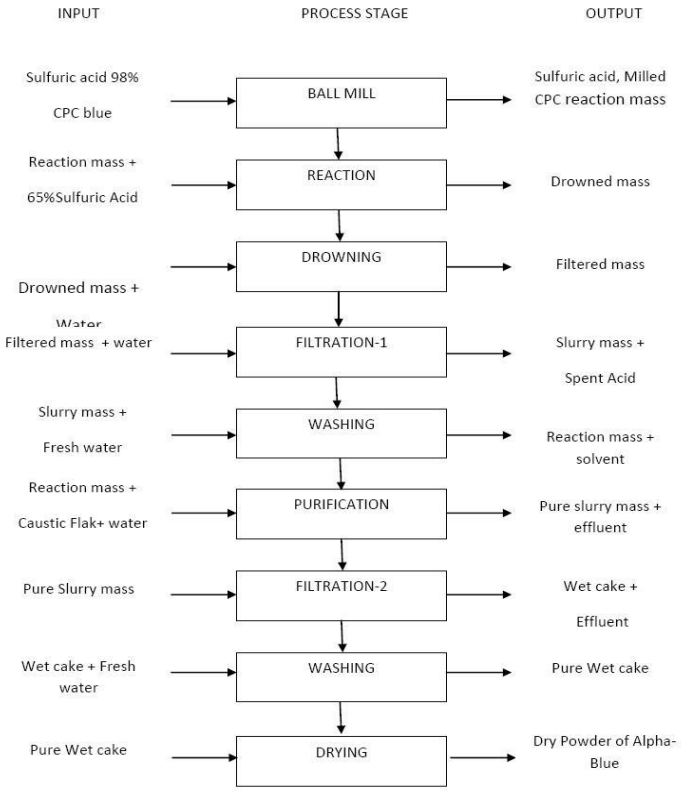

Figure 2 Block diagram for the manufacturing of alpha-blue

B. Process Flow Diagram

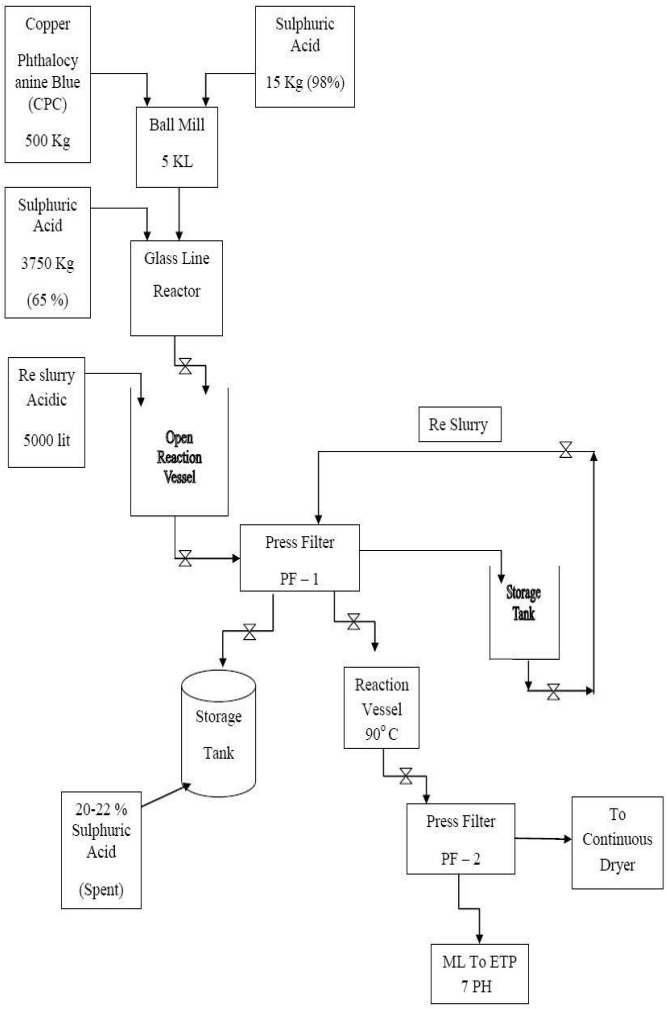

Figure 3 Process Flow diagram for the manufacturing of alpha-blue

I. CRITICAL EVALUATION OF HAZARD

A. Handling of 70% H2SO4

Sr. No	Name of Hazardous Substance	CAS Number	Max. Stored in MT/KL	Mode of Storage	State & operating Pr. & Temp	Type of Hazardous possible	Control Measures Provided
1	Sulphuric Acid (98%)	7664-93-9	20.0	MS Storage Tank- 2 Nos	Liquid Ambient	Toxic, Irritative	Suitable PPE provided fire extinguisher provided at production and storage area for flammable and non-flammable chemicals. Proper Housekeeping particles. Proper loading and unloading of particles.
2	Sulphuric Acid (65%)	7664-93-9	20.0	MS Storage Tank- 2 Nos	Liquid Ambient	Toxic, Irritative	

Figure 4 Hazard data for Sulphuric Acid

Hazard Identification

Sulfuric acid is very hazardous caused to our health, so we must used our safety precaution like,

- To avoid contact with skin and eyes
- Wear suitable protective clothing, gloves and eye/face protection.
- In case of accident or if you feel unwell, seek medical advice immediately.
- Clear area of all unprotected personnel, if contamination of sewers or waterways has occurred advice local emergency services.

Method and Materials for containment and clean up

Slippery when split. Avoid accidents, clean up immediately. Wear protective equipment to prevent skin and eye contact and breathing in vapors. Work up wind or increase ventilation. Contain-prevent run off into drains and waterways. Use containers or drums for disposal. Wash area down with excess water.

Condition for safe storage

Store in cool place and out of direct sunlight. Store away from food stuffs. Store away from incompatible materials (avoid contact with food stuffs).

Precaution for safe handling

Avoid skin and eye contact and breathing in vapor, mists and aerosols. Keep out of reach of children. Always add the acid to water, never the reverse.

A. Handling of CPC Blue

Sr. No	Name of Hazardous Substance	CAS Number	Max. Stored in MT/KL	Mode of Storage	State & operating Pr. & Temp	Type of Hazardous possible	Control Measures Provided
1	CPC Blue	147-14-8	10.0	HDPE Bags	Solid Ambient	Irritative	Suitable PPE provided fire extinguisher provided at production and storage area for flammable and non-flammable chemicals. Proper Housekeeping particles. Proper loading and unloading of particles.

Figure 5 Hazard data for CPC Blue

Hazard Identification

Copper phthalocyanine Blue is irritative hazardous material, it caused to our skin, eye, and inhalation.

- It may caused mild eye irritation
- Prolonged or repeated contact may caused mild skin irritation.
- It may cause nausea.

Condition for safe storage

Store in a cool, dry, well-ventilated area. Keep container sealed when not in use.

Precaution for safe handling

Avoid dust formation. Keep away from ignition sources. Avoid breathing dust and contact with skin, eye and clothing. Wash with water thoroughly after handling.

B. Handling of Caustic soda Flake

Sr. No	Name of Hazardous Substance	CAS Number	Max. Stored in MT/KL	Mode of Storage	State & operating Pr. & Temp	Type of Hazardous possible	Control Measures Provided
1	Caustic Flacks	1310-73-2	10.0	HDPE Bags	Solid Ambient	Irritative	Suitable PPE provided fire extinguisher provided at production and storage area for flammable and non-flammable chemicals. Proper Housekeeping particles. Proper loading and unloading of particles.

Figure 6 Hazard data for Caustic Soda flake

Hazard Identification

Caustic flake is hazardous to our health, it caused prolonged contact with dilute solutions of dust has a destructive effect upon tissue.

Condition for safe storage

Store in a cool, dry well ventilated area, Prevent physical damage. Keep away from sources of heat, moisture and incompatibles.

Precaution for safe handling

Always store in tightly sealed, properly labeled, original container. Follow label instructions and precautions.

C. Handling of Oleic acid

Sr. No	Name of Hazardous Substance	CAS Number	Max. Stored in MT/KL	Mode of Storage	State & operating Pr. & Temp	Type of Hazardous possible	Control Measures Provided
1	Oleic Acid	112-80-1	10.0	Container	liquid Ambient	Irritative	Suitable PPE provided fire extinguisher provided at production and storage area for flammable and non-flammable chemicals. Proper Housekeeping particles. Proper loading and unloading of particles.

Figure 7 Hazard data for Oleic acid

Hazard Identification

It's a highly flammable, irritant, avoid contact and inhalation, it caused central nervous system eyes, liver, reproductive system, respiratory system, skin. May be harmful by inhalation, ingestion, or skin absorption. May caused eye or respiratory system irritation.

Condition for safe storage

Keep away from heat, sparks, and flame. Keep tightly closed. Store at correct temperature. It's a hygroscopic in nature.

Precaution for safe handling

Avoid breathing (dust, vapor, mist, gas). Avoid prolonged or repeated exposure. Keep away from sources of ignition. Prevent the buildup of electrostatic charge. Do not reused previous container.

D. Air Quality Control

1. Process Gas Emission Control

For process gas emission control company has to a new scrubber system proposed for control of sulfuric emission to comply with increase load due to higher production capacity.

2. Flue gas emission system

Natural gas is to be used as fuel as preferable fuel for boilers, thermic fluid heater, however in absence of wood/coal/lignite shall be used. For controlling the flue gas emissions from combustion of wood/coal/lignite, it is proposed to provide multi cyclone dust collector and bag filter.

Stack No.	Stack Attached to	Stack Hight in m	Fual used and rate of Combustion	Parameter	Permissible limits	Control measures provided
1	Small industrial boiler 600 kg/hr	20	Natural gas 700 SM3/day	Pearticular SO_2 NO_x	150 mg/Nm3	Multi cyclone dust collector and bag filter
2	Thermic Fluid heater					

Figure 8 Stack data

E. Water Pollution

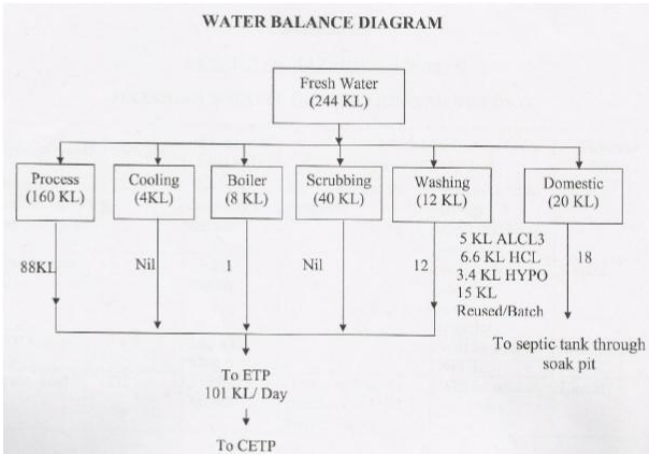

Figure 9 Water balance for alpha-blue production

II. HAZOP ANALYSIS

The what if scenario is presented in table below:

Sr No.	Causes	Implication
1	If Cooling water line to ball mill is not insulated	Ball mill can't get proper cooling medium so for milling we can't maintain proper temperature.
2	Concentrated Sulfuric acid line from storage tank to Glass line reactor is leakage	It caused problem in plant, also we charged less quantity of sulfuric in glass line reactor, so CPC can't properly mixed with sulfuric acid, and we can't get Alpha-blue material.
3	If heating valve fail to heating Glass line reactor	CPC cannot properly mix with sulfuric acid and so it can't converted to alpha-blue.
4	When unloading ball mill, hopper pipe is break	Ball mill CPC west in plant, so we get alpha-blue in less quantity.
5	In milling section if main hole gasket of ball mill is break	While rotating CPC comes outside of ball mill and this is wastage of CPC, so we can't get further process result.
6	In drowning section if we used small quantity of ice	Both slurry mixture can't get suddenly fall to low temperature, if suddenly high to low temperature is not achieve then we can't get alpha-blue in last stage.
7	If Press filter feeding line is block	We can't get proper pressure for press filter so feeding is going in low pressure, so we can't get good strength of alpha-blue
8	In filtration section if feeding line is not properly	Some In coming material block the whole line so press filter is not working properly
9	while air drying air quantity is less	Material can't properly convert to wet cake form, and so in next step we get less amount of material.
10	In Purification section heating valve is not working properly	We can't get higher temperature up to (80-90^{o}), and so we get alpha-blue in less strength, dull in color.
11	In separated filter dryer (SFD) air pressure is less due to boiler problem	Drying of material should be less, so we can't get material in pure dry form
12	If spent line from press filter to storage tank is leakage	Highly acidic spent acid mixed with water or material caused create hazardous problem.

Figure 10 HAZOP Analysis

III. MITIGATION BY PROCESS MODIFICATION

In this mitigation I try to modify the process of alpha-blue pigment, from this process I can get higher concentration of sulfuric acid which is directly used in plant process either to selling out side. So this modify process is like this,

Process:-

Step-1

- Take 70% Sulfuric Acid with dilution make 63% sulfuric acid (200gm) and take 50 gm of Milled CpC (15hr)
- Both materials are mixed at temperature below 20^{o} C , properly up to 1hr in CSTR.
- After when 1hr is completed material goes to thick and then adds 150 to 170 ml water and then start to filtration.
- In filtration we get 55% sulfuric acid in spent, washing wet cake up to ph-6.5, we get wet cake.

Step-2

- In this wet cake we add water and heating below 80-90^{o} C.
- Add caustic 1.5gm for set ph-9 and also add TLS Solution 2.5gm.
- All are mixed up to 1hr then further starts filtration, washing , get wet cake
- After wet cake goes to dryer for drying.
- Muller Sample testing is 100% match with standard sample.

IV. CONCLUSION:-

Here from this seminar I conclude that while modification of alpha-blue process we save hazardous chemical, because I get maximum spent up to 55% of sulfuric acid, so this is directly sold in outside market demand. So here hazardous material storage is not to need. And by this process also we save environment because from last step we get 7ph of water which is directly send to drainage. So also we have to less water pollution.

ACKNOWLEDGMENT

The preferred spelling of the word "acknowledgment" in American English is without an "e" after the "g." Use the singular heading even if you have many acknowledgments. Avoid expressions such as "One of us (S.B.A.) would like to thank ... ." Instead, write "F. A. Author thanks ... ." **Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page, not here.**

REFERENCES

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