**METHOD OF SYNTHESIS OF IRON OXIDES (GOETHITE) USING CO-PRECIPITATION METHOD.**

Goethite will be synthesized using co-precipitation method. It involving involving addition of 4 M solution of potassium hydroxide to 50 mL of 1 M solution of ferric nitrate will be dropwise with constant and rapid stirring until pH of the solution reaches in the range of 13–14. In order to reduce the particle size, the stirring speed will be increased and the drop size will be decreased. After 10 min stirring, similar volume of potassium hydroxide will be added to make the solution further alkaline. A red-brown precipitate will be obtain and diluted to 10 times of it’s volume employing double-distilled water. It will be kept in an oven for 72 h at 70–75 °C. Then the Goethite will be obtained as light yellow-coloured precipitate which will be washed 5–6 times with double-distilled water and dried in an oven at 50–55 °C.

**FLOW CHART FOR THE EXPERIMENT**

Start

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Prepare Solutions:

50 mL 4 M KOH

50 mL 1 M Fe(NO3)3

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Add 4 M KOH dropwise to 1 M Fe(NO3)3 with stirring

until pH reaches 13–14

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Increase stirring speed and reduce drop size

to reduce particle size

↓

Observation after 10 mins:

Check pH and reaction progress

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Adjustment (If required):

- Add similar volume of 4 M KOH dropwise

to maintain desired pH (13–14)

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Precipitate Formation:

Allow red-brown precipitate to form

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Dilute precipitate with 10x volume of double-distilled water

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Heat at 70–75°C for 72 hours for nanoparticle formation

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Collect Precipitate:

Centrifuge or filter to collect goethite nanoparticles

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Wash Precipitate:

Wash 5–6 times with double-distilled water

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Dry Precipitate:

Dry goethite nanoparticles at 50–55°C

↓

End

CHEMICAL PRECIPITATION METHODS OF ZINC OXIDE NANOPARTICLES

The zinc oxide and reducing agents will measured by beam balance. 12g of the sodium hydroxide (NaOH) solution will be blended in 70mL of twice distilled water and agitated. Under gentle magnetic stirrer for 30 min. Again, 4g of Zn(NO3)2.6H2O will be dissolve into double-distilled water of 30mL and stirred continuously for 20 min. Slowly drop by drop, Zn(NO3)2.6H2O solution will be add to NaOH solution and stir continuously for 2 hr at 60°C. At this stage, gel-like solutions will form and left to cure in an oven at a temperature of 160°C for 10 hr overnight. Then, the sample will be taken furnace and calcinated at 300°C for 6 hrs.

**FLOW CHART FOR THE EXPERIMENT**

Start

Prepare NaOH Solution

12g NaOH in 70mL water

Agitate for 30 min

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Prepare Zn(N03)2.6H20 Solution

4g Zn(N03)2.6H20 in 30mL water

stir for 20 mins

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Add Zn(NO3)2.6H20 to NaOH solution

Dropwise addition with continuous stirring

Maintain stirring at 600c for 2 hours

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Gel-like solutions formed:

Cure in oven at 1600C for 10 hours

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Transfer to Furnace

calcinate at 3000c for 6 hours

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End