Experiment

Aim

To prepare Colloidal Solution of Aluminium Hydroxide, $[Al(OH)_3]$ sol.

Theory

Aluminum hydroxide sol is hydrophobic. It is obtained by hydrolysis of aluminium chloride.

$$AlCl_3(aq.) + 3H_2O \rightarrow \underset{\text{(Aluminium hydroxide)}}{Al(OH)_3} + 3HCl$$

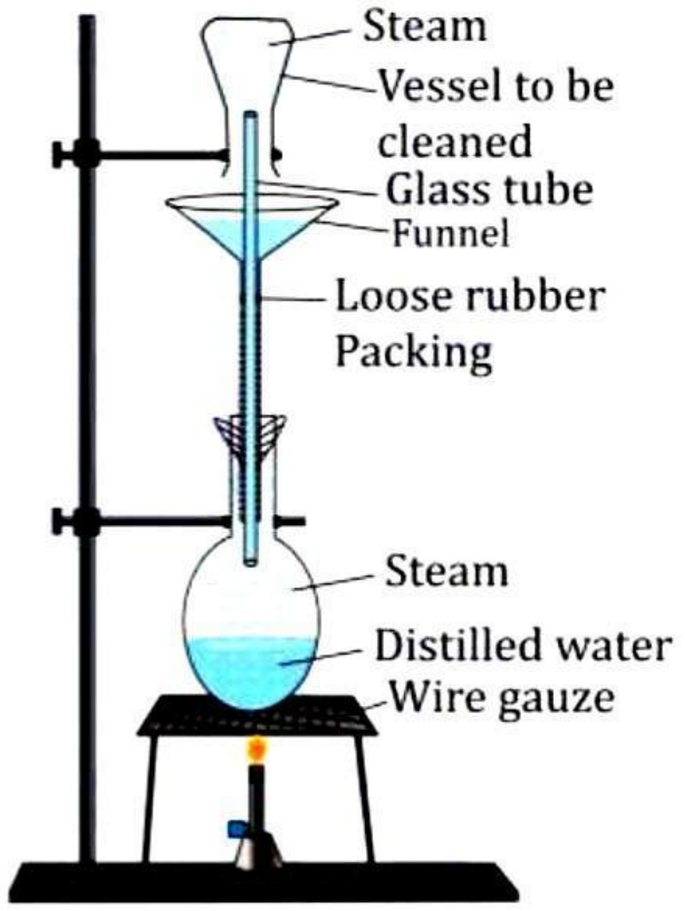
The hydrolysis reaction produces insoluble aluminium hydroxide particles which undergo 'amalgmation' i.e. cluster formation to yield bigger particles of the colloidal size. These particles adsorb Al^{+3} ions preferentially from the solution to result in positively charged solution. HCl which is produced during the preparation process tries to destabilize the sol and so must be removed by dialysis process, otherwise sol will not be stable. The sol is represented as $Al(OH)_3$.

Material Required

Conical flask (250 ml), beaker (250 ml), a boiling tube, glass rod, funnel, filter paper, round-bottom flask, iron stand with a clamp, wire gauze, tripod stand, burner, a burette or a dropper, 2% solution of Aluminium chloride (prepared by dissolving 2 g of pure $AlCl_3$ in 100 ml distilled water) and distilled water.

Procedure

1. Take a 250 ml conical flask and clean it by a steaming-out process as shown in (Fig. 2).
2. To this cleaned flask, add 100 ml of distilled water and heat it to boil by placing the flask on a wire gauze.
3. Add Aluminium chloride solution dropwise (using a burette or a dropper) to the boiling water.
4. Continue heating until a deep red or brown solution of Aluminium hydroxide is obtained. Replace the water lost by evaporation during boiling at regular intervals.
5. Keep the contents of the conical flask undisturbed for some time at room temperature. Label the solution as "Aluminium chloride sol".



Cleaning of glass apparatus
Fig.2.

Result

A colourless sol. of $Al(OH)_3$ is obtained.

Precautions

All material should be cleaned by the steaming out process since the sol. is precipitated or coagulated in the process by adding either sodium sulphate solution or sodium hydroxide solution.

VIVA VOCE

Q 1. What is the significance of preparing a colloidal solution of aluminum hydroxide in chemistry?

Ans. The preparation of a colloidal solution of aluminum hydroxide allows us to study the properties and behavior of metal hydroxide colloids, which have applications in industries such as water treatment, ceramics, and pharmaceuticals.

Q 2. How does the colloidal nature of aluminum hydroxide differ from its behavior in a true solution or a suspension?

Ans. In a colloidal solution, aluminum hydroxide forms dispersed particles that are intermediate in size between true solutions and suspensions, exhibiting characteristics such as the Tyndall effect and Brownian motion. In contrast, in a true solution, aluminum hydroxide ions are uniformly dissolved, while in a suspension, they settle out over time.

Q 3. Describe the method you used to prepare the colloidal solution of aluminum hydroxide.

Ans. The colloidal solution of aluminum hydroxide can be prepared by adding a solution of aluminum salt to water under controlled conditions, followed by the addition of a base to precipitate the aluminum hydroxide colloid.

Q 4. What role does the base (alkali) play in the formation of the colloidal solution of aluminum hydroxide?

Ans. The base reacts with the aluminum salt to precipitate aluminum hydroxide as a gelatinous colloid. It also helps in controlling the pH of the solution, which is crucial for stabilizing the colloidal particles.

Q 5. How would you ensure the uniform dispersion of aluminum hydroxide particles in the colloidal solution?

Ans. To ensure uniform dispersion, it is important to add the aluminum salt solution and base slowly and with continuous stirring, allowing sufficient time for the precipitation of finely divided aluminum hydroxide particles.

Q 6. What factors affect the stability of the colloidal solution of aluminum hydroxide?

Ans. Factors such as pH, temperature, presence of electrolytes, and degree of dispersion can affect the stability of the colloidal solution by influencing the balance between attractive and repulsive forces among the particles.

Q 7. How could you modify the experimental procedure to produce a more concentrated colloidal solution of aluminum hydroxide?

Ans. To produce a more concentrated colloidal solution, one could use a higher concentration of aluminum salt solution or reduce the volume of water used for dispersion while maintaining the same amount of aluminum hydroxide precipitate.

Q 8. Can you explain the mechanism of stabilization of aluminum hydroxide colloids?

Ans. The stabilization of aluminum hydroxide colloids is achieved through electrostatic repulsion between the negatively charged hydroxide ions on the particle surface, preventing aggregation and sedimentation.