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2,813,067

HYDRAZINE MANUFACTURE

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No Drawing. Application June 29, 1956,
Serial No. 594,703

4 Claims. (Cl. 204—59)

This invention relates to producing hydrazine by electrolysis.

In accordance with this invention, a solution of an alkaline earth metal amide in formamide is subjected to electrolysis. Hydrazine is formed at the anode during the electrolysis, and the alkaline earth metal is deposited at the cathode. The so-formed hydrazine is separated from the electrolysis solution and comprises a product of this invention. The deposited alkaline earth metal can also be separated from the electrolysis solution. This metal can comprise a product of the process, or the metal can be externally reacted with ammonia to form metal amide which is reused in the production of hydrazine.

Formamide is used as solvent for the alkaline earth metal amide in this invention. Formamide has an exceedingly high dielectric constant, and also has high solvency for the metal amides. This combination of properties insures a high degree of dissociation of large quantities of metal amides in the electrolysis solution. Lower voltages can be employed in the electrolysis with resulting lessened electrical energy loss as heat.

Formamide has the additional advantage of being relatively high boiling. In a specific embodiment of this invention, as fully described hereinafter, the electrolysis can be conducted at a temperature whereby hydrazine is liberated from liquid electrolysis solution as a gas and thus the separation of hydrazine is facilitated.

The metal amide used in the invention can be any alkaline earth metal amide. It is preferred to use calcium amide. However, barium amide, strontium amide and magnesium amide can also be used.

In carrying out the invention, the alkaline earth metal amide is dissolved in formamide in high concentration. This resulting solution is subjected to electrolysis; i. e., electrodes are immersed in the solution and direct current carried by conducting ions in the solution is passed through the solution. Hydrazine is formed at the anode, and alkaline earth metal is deposited at the cathode. The hydrazine is separated from the electrolysis solution and comprises a product of the invention. Alkaline earth metal is also separated from the electrolysis solution. Thus separated metal can comprise a product of the invention. Alternatively, the alkaline earth metal can be reacted with ammonia to form alkaline earth metal amide which can be reused to produce hydrazine.

The electrolysis is carried out in accordance with tech-

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niques which are known to those skilled in the art. The source of direct current can be a battery or any other means commonly employed in the electrolysis art; anode current densities in the range of about 5 to 200 amps. per sq. ft. are suitable, although current densities outside this range can be employed. Voltages in the range of about 5 to 50 volts are suitable, although voltages outside this range can be employed. The electrodes can be carbon or metal electrodes, or metal plated carbon electrodes. Continuous or batch-type electrolysis techniques can be employed.

In a preferred embodiment of the invention, the electrolysis is conducted at conditions such that the hydrazine formed is a vapor while the electrolysis solution is liquid. In this embodiment, hydrazine is readily separated as product from the electrolysis solution. At atmospheric pressure, temperatures above about 113.5° C. and below about 193° C. can be employed in this embodiment of the invention. At reduced pressures, lower temperatures can be employed with the separation of hydrazine as a vapor from the electrolysis solution. The electrolysis need not be performed in accordance with this embodiment, however. Conditions can be employed whereby hydrazine is formed as a liquid. The liquid hydrazine can be recovered by external distillation from the electrolysis solution.

The following illustrates practice of an embodiment of the invention:

Calcium amide is dissolved in formamide in high concentration, and the resulting solution is subjected to electrolysis. A graphite anode and a calcium-coated graphite cathode are immersed in the solution. Direct current is passed through the solution; an anode current density of about 20 amps. per sq. ft., and a voltage of about 15 volts are employed. The temperature of the solution during the electrolysis is maintained at about 130° C. by external means. Hydrazine gas is formed at the anode and this gas is continuously withdrawn from the electrolysis chamber as a product of the process. Metallic calcium is deposited at the cathode as a second product of the process.

I claim:

1. The method of making hydrazine which comprises subjecting a non-aqueous solution comprising an alkaline earth metal amide in formamide to direct current electrolysis, and separating hydrazine from the electrolysis solution.

2. The method according to claim 1 wherein the metal amide is calcium amide.

3. The method of making hydrazine which comprises subjecting a non-aqueous solution comprising an alkaline earth metal amide in formamide to direct current electrolysis, said electrolysis being conducted at conditions such that hydrazine is normally a vapor and separating hydrazine vapor from the electrolysis solution.

4. The method of making hydrazine which comprises subjecting a non-aqueous solution of calcium amide in formamide to direct current electrolysis at a temperature above 113.5° C. and below 193° C., and separating hydrazine vapor from the electrolysis solution.

No references cited.