UNITED STATES PATENT OFFICE

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AMMONIA RECOVERY IN SODA ASH PRODUCTION

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1 Claim. (Cl. 23—193)

1 This invention relates to the production of soda ash and is particularly directed to that portion of the method and apparatus in which ammonia is recovered from the carbonated liquor from which soda bicarbonate has been removed, which constitutes one stage in the well known production of soda ash.

Ammonia is a relatively expensive reagent in the production of soda ash. Its efficient recovery is thus an important consideration. In standard practice the ammonia still or distiller is a tall column, say 80 feet high, consisting of a series of cast iron sections 6 to 8 feet in diameter. Heat is introduced at the bottom of the column. Scale formation creates a problem necessitating periodic cleaning of the column. To reduce sedimentation and scale formation, sand traps are usually employed to remove larger solid particles from the preformed liquor. Installation and operating costs are high.

The object of the present invention is to reduce greatly the installation and operating costs of the ammonia recovery system. More particularly the object is to provide a method and apparatus for the recovery of ammonia which is more economical in installation as well as operating costs, and which substantially eliminates sedimentation and scale formation, thus permitting more continuity and efficiency of operation.

Other objects will appear from the following description with reference to the accompanying drawings, in which:

Figure 1 is a side elevation, partly in section of the distiller unit, and

Figure 2 is an end elevation, also partly in section, of the unit.

In the drawings, 1 is a chamber having firebrick or other walls 2. Horizontally disposed within the chamber is a plurality of closed tubular members 3 connected in series and preferably one below the other for gravity flow. Within each tubular member an agitator 4 of the screw conveyor type extends from the inlet end to the discharge outlet and is driven by any suitable means 5. At the discharge end of the tube the blades of the screw conveyor are flattened longitudinally to provide a discharging portion 4'. The discharge outlet consists of an opening 6 in the wall of the tube so arranged that the screw conveyor discharges the liquor over its lower lip 7 into a conduit 8 through which the liquor falls directly into the inlet end of the next tube of the series without substantial contact with the wall thereof to prevent scale formation therein. The conduit 8 discharges directly into a zone of the succeeding cylinder of the series occupied by the screw conveyors. The pipe 9 leads from the usual prelimming chamber not shown, if one is used, or from other source of filter, liquor and lime, and discharges liquor into the initial cylinder of the unit. Ammonia and water vapor liberated in each tubular member are withdrawn through pipe 10 and may be conveyed through a manifield 11 to the normal reflux tower, not shown. 12 is a discharge outlet from the last tube of the series. The chamber 1 is preferably heated by waste heat from boiler or calciner flue gases, but may be heated by direct oil, gas or coal firing as desired, and a substantially constant temperature is maintained about each of the progressive ammonia distilling tubes in the unit.

In operation the usual prelimming liquor, or liquor and lime, is fed into the initial tube of the series and is continuously conveyed under constant agitation through the successive tubes to liberate progressively ammonia under the influence of the heat to which each tube is subjected. The constant agitation by the spiral conveyors eliminates sedimentation and makes the sand traps or the like unnecessary. It also avoids scale formation and thus eliminates the necessity for the frequent cleaning operations required in the usual system. It permits continuous operation and avoids dilution of the liquor caused by the periodic washing of the sand traps in standard practice. The agitation constantly exposes new surfaces of liquor to the heated walls of the tubes and causes more rapid liberation of ammonia. Since each distillation tube is heated, rapid elimination of ammonia is effected in the initial tubes and little ammonia is left for liberation in the final tube of the series. This eliminates loss of ammonia in the effluent discharged through pipe 12. It will be observed that because of the location of the discharge outlet 8 and lip 7 each heated distiller tube contains a substantial body of liquor to absorb heat from the surrounding chamber. Thus an effective distillation temperature is maintained during the passage of the liquor through each tube.

The external heating of the distiller tubes avoids dilution of the liquor as when the latter is heated by injected steam in standard practice. This gives a discharge liquor having a higher concentration of calcium chloride and the latter may be more economically recovered. The tubes may be steam jacketed and thus avoid the use of the chamber 1. By thus heating the tubes the temperature of the respective tubes may be readily varied for most efficient liberation of the am-
monia. The external heating of each tube at a reduced temperature permits a more rapid rate of feed of the liquor and thus increases the capacity of the distiller.

Hot milk of lime from the hydrator and hot liquor from the reflux tower may be fed directly to the distiller, thus eliminating the usual lime settling tank and preliminaries with the attendant complications. This makes use of the heat of the milk of lime. Furthermore, the hydrator may be eliminated by feeding crushed quicklime directly into the distiller with the hot liquor from the reflux tower to utilize fully the heat of hydration of the lime and thus reduce still further the amount of external heat supply required. The continuous agitation of the screw conveyors in the distiller tubes makes this possible.

Owing to its construction the distiller unit may be operated under an internal partial vacuum and thus further reduce the amount of heat required to distill the ammonia. The reduced pressure within the distiller unit may be produced by use of the ejectors in the absorber unit as disclosed in copending application No. 540,786, now Patent No. 2,446,442, issued August 3, 1943.

When the feed is adjusted to most efficient conditions of temperature and rate of flow, they may be maintained constant over long periods because of the elimination of sedimentation, scale and the like which, in the usual system, require periodical shut-down for cleaning, and the maintenance of auxiliary equipment. In the standard system the distiller acts as a bubbling cap plate still with its constant refluxing and varying plate concentrations. In the present system there is no refluxing in the distiller since the ammonia vapours are removed from each distiller tube and the concentration is effected entirely in the reflux tower. This insures easy recovery of the ammonia with reduced loss in the effluent and, at the same time, requires a minimum of control during continuous operation.

It will be observed that the distiller unit of the invention may be made of ordinary pipe or plate and is thus much cheaper in construction than the standard distiller unit now in use.

The method and apparatus as specifically described with reference to the recovery of ammonia from the carbonated liquor in soda ash production may also be used for purifying and concentrating the waste distiller liquor. When such liquor is passed through the distiller unit lime and sodium chloride will precipitate out leaving a concentrated calcium chloride brine. The precipitated solids being carried through the distiller tubes are removed from the concentrated calcium chloride solution.

It will also be apparent that the invention may be employed in any art where concentration of solutions is required and particularly in the presence of precipitating solids. For example, in the production of salt, sugar and the like, where continuous operation on large volumes of solutions is involved.

It is to be understood that various changes may be made without departing from the spirit and scope of the invention as defined in the following claim.

I claim:

In the production of soda ash, the method of recovering ammonia from filter liquor which comprises maintaining a series of separate bodies of predetermined fixed depth of liquor and lime, continuously feeding a supply of fresh liquor and lime to the first body only of said series, continuously discharging a portion of the last body in the series, continuously withdrawing by gravity flow a portion of the first and intermediate bodies and feeding each withdrawn portion to the next body in the series, separately agitating and sweeping each body to prevent sedimentation therein and to discharge solids with the liquor in each said withdrawn portion, continuously subjecting all of said bodies to a common heating medium maintained free of contact with the bodies, maintaining each of said bodies free from contact with external gases to prevent dilution therewith of the liquor and ammonia vapors arising from said bodies, and separately removing said ammonia vapors from each body as it is liberated therefrom.

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