GLASS CHLORINATION EQUIPMENT

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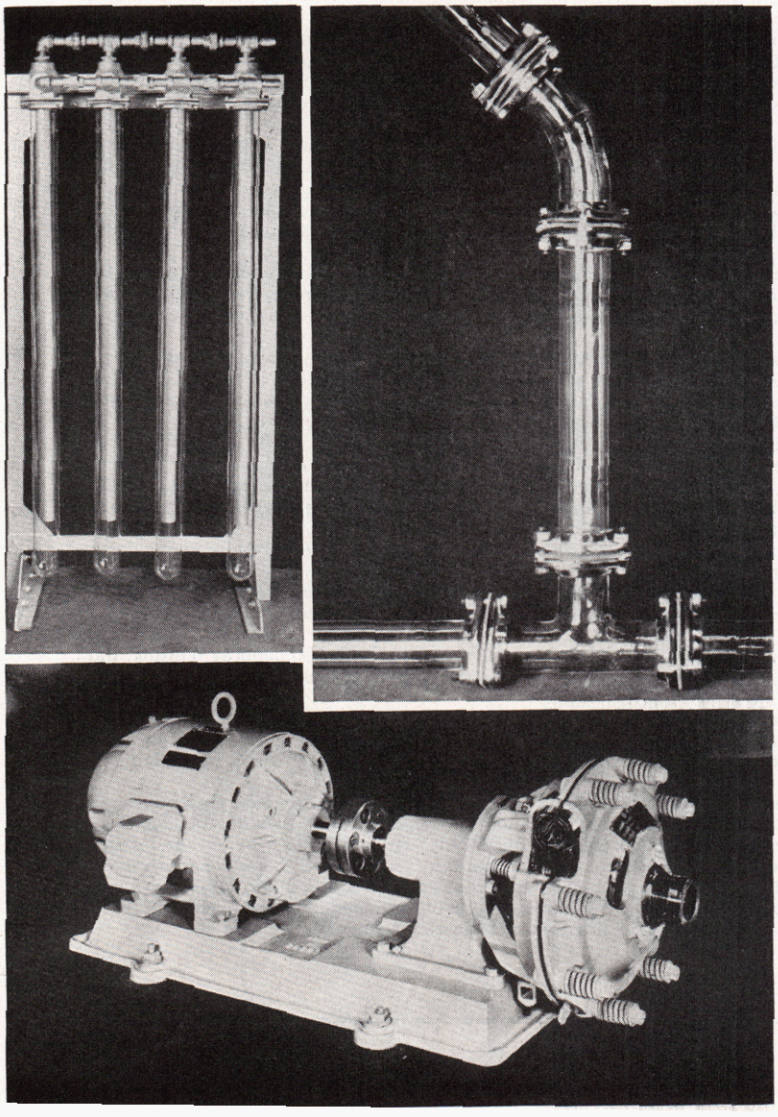
PROGRESS in commercial application of chlorination processes has been substantially contingent upon development of suitable materials of construction to withstand the severe corrosion of such operations. Among the many materials of construction which have attained commercial importance, glass has proved to be particularly serviceable for handling of chlorine, bromine, and their many compounds.

Borosilicate glass with its low thermal expansion and marked chemical stability provides a material uniquely resistant over a wide temperature range to the destructive effects of powerful oxidizing agents, hydrochloric acid, and hydrobromic acid. In the form of flanged piping, socket piping, heat exchanger tubing, fractionating columns, and centrifugal pumps of standard design, such glassware lends itself well to fabrication of highly useful equipment and accessories for chlorine and bromine processing.

Glass equipment has proved to be dependable and economical in the following applications:

(*Upper left*) "PYREX" CANDLE COOLERS; (*upper right*) "PYREX" PIPING ASSEMBLY; (*below*) ASSEMBLY VIEW OF NASH GLASS PUMP WITH DIRECT-CONNECTED DRIVING MOTOR



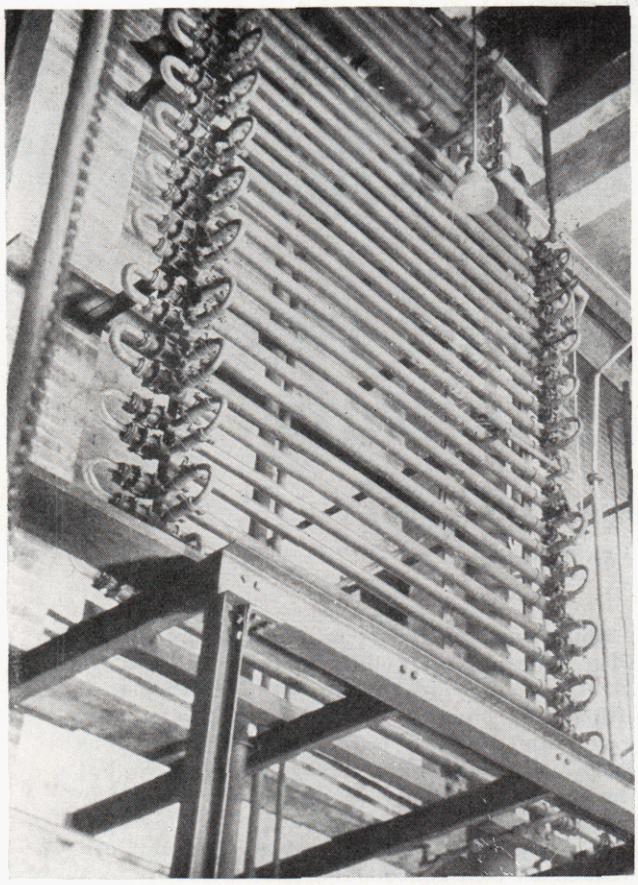
Manufacture of Halogens. Glass piping and tubing are being used for conveying hot salt brines to and from electrolytic caustic cells producing chlorine. Resultant elimination of metallic precipitates in the cell and insulation of pipe lines against stray current corrosion are noted. Moist chlorine gas may be conducted away from the cells to succeeding coolers, dehydrators, and compressors.

In the manufacture of bromine and bromides, glass piping and accessory equipment are ideal for handling the very corrosive vapors and liquids without impairment of their purity.

Gas Cooling. Although the thermal conductivity of glass is relatively low compared to metals, the over-all heat transfer rates obtained with glass in many instances are of substantial magnitude and compare well with materials having much greater conductivity because the principal resistances to heat flow are the films bordering each side of the pipe wall.

Flanged glass piping assembled with metal water jackets and return bends is a popular type of cooler construction employed for handling wet bromine and chlorine gases. Another method of utilizing glass tubing employs "cascade" effect with cooling water pouring down over a bank of parallel tubes from a weir box. Still a third type is the usual tube-sheet cooler employing stoneware headers.

Liquid Cooling and Conveying. Although borosilicate glass is immune to attack by the halogen derivatives (except hydrofluoric acid), assembly of piping and fittings is by means of flanged compression joints, and this necessitates use of suitable gasket material to resist the wide variety of combinations of acids and solvents. Design of the pipe joint is such that very little of the gasket material is exposed to attack, and for almost all commercial mixtures of acids and halogen compounds, gasketing materials are available which ensure satisfactory joints over wide temperature ranges. Conveying and cooling of hot acid-solvent mixtures in glass equipment have consequently proved to be widely applicable.



WATER-JACKETED GLASS HEAT EXCHANGER ASSEMBLY

Initial heat transfer rates obtainable with glass heat exchangers are not usually diminished greatly over long operating periods. This is partly because of immunity to pitting and scaling by corrosive action; but unique and somewhat inexplicable is the notable absence of substantial scale deposition from cooling water.

Specific uses of glass lines for transporting hydrochloric acid range from air lifts for the old style tourills to gasketed pipe lines conveying cold acid from storage tanks via glass pump through heat exchanger to steel pickling baths. The attachment of glass piping to other materials offers no particular problem.

Fractionation. Glass bubble plate columns complete with glass bubble caps, bolts, and nuts afford means for continuous separation and recovery of hot strong hydrochloric and hydrobromic acid solutions from the by-product wastes of halogenating reactions In addition to bubble-cap towers, efficient fractionation can be carried out in packed glass columns which use a shell similar to the plate columns or one constructed from large socket pipe. Glass Raschig rings are available in a range of sizes. Reflux condensers constructed from standard glass heat exchanger piping are useful adjuncts to the fractionating columns.

Absorption. Return-bend piping arranged for counter or parallel flow of gas and liquid is often applicable for scrubbing out residual acids from chlorinated solvents. To absorb hydrogen chloride or bromide vapors, thinner wall water-jacketed heat exchanger tubing facilitates economical absorption and cooling in one operation.

Absorption columns are generally constructed as packed type towers, similar to fractionating towers. An example is continuous recovery of nitrogen dioxide (NO_2) vapors to form high-purity nitric acid in a glass column packed with glass Raschig rings using a glass centrifugal pump to circulate the absorbing acid through glass heat exchangers and back over the tower packing.

Halogenation. Equipment used for chlorinating or brominating a substance varies widely according to the nature of the reaction involved and the means required to carry it forward. Glass windows for transmitting ultraviolet light from arc lamps to reactants have been devised for certain chlorinations which require actinic light activation and which must be carried out in large vessels. In liquid-phase chlorinations which produce hydrochloric acid as a by-product of the reaction, use of glass pipes for introducing chlorine into the solution eliminates one source of contamination. To break up a chlorine stream into very fine bubbles in a liquid being gassed, resort has been made to fine-mesh screens. The availability of improved types of woven glass cloth is of interest in this connection.

Glass reflux condensers may be used above chlorination or bromination tanks to separate volatile product from valuable but corrosive by-product acid gases.

One of the more recent applications of glass equipment which has found wide commercial usage is the cooling of sodium hypochlorite solutions when manufactured by direct injection of liquid chlorine into strong caustic soda solutions. Control of the temperature is necessary to prevent chlorate and chlorite formation and thus improve yield and stability. Flanged glass tubes having one end closed (like a large test tube) are fitted with a metal head to form a "candle cooler" unit which is immersed in the solution while the coolant rapidly circulates inside the tube. Although it is generally considered that glass has relatively poor resistance to strongly alkaline solutions, long economical service life is obtained in hypochlorite manufacture. Harmful contamination is thus minimized with resultant improvements in color and stability of the bleach solution.

BOTTOM OF "PYREX" FRACTIONATING COLUMN, 23.5 INCHES I. D.