

the course of an investigation of the possibility of using other methods for the purification of dynamite and saponification glycerins, a new process was developed, involving a liming operation similar to that used in the sugar industry. The glycerin produced by this process is not of U. S. P. grade, but it is white and almost odorless and should find applications in several industrial fields. It is also superior to the refined white glycerin obtained by charcoal treatment of dynamite and saponification glycerin.

The purification of a good grade of saponification glycerin is carried out as follows:

The saponification glycerin is diluted with water to a hydrometer, reading of 16° Bé., and pure lime corresponding to about 5% of the glycerol present is added. The mixture is stirred at room temperature for half an hour, and then the temperature is raised to 80° C. and maintained at that temperature for half an hour while the stirring is continued. Carbonation with CO₂ is then started and continued at approximately 70° C. with constant stirring. The carbonation is considered complete when the mixture has become neutral to litmus paper.

The calcium carbonate and impurities are filtered off while the glycerin is still hot, and the filtered glycerin is again diluted to 16° Bé. with water. Heating is resumed and at 95° C., powdered charcoal equivalent to 3% of the glycerol present is added. A mixture of bone black and Nuchar is suitable for this operation. After stirring for about one hour, the hot mixture is filtered; a water-white glycerin containing about 60% glycerol is obtained.

This glycerin may be used for some purposes without any further concentration.

If a concentrated glycerin is desired, it is best obtained by vacuum distillation of the water, with or without steam blowing. The temperature of the glycerin thus treated must not be allowed to rise above 135° C., however, if the color of the finished product is to be kept as nearly water white as possible.

An additional treatment of the concentrated glycerin with 2% Nuchar for half an hour at 70° C. finally yields a white and nearly odorless glycerin of excellent taste.

Though tests on this finished glycerin show that it does not come within U. S. P. limits, it is an exceptionally good grade of refined industrial glycerin.

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THE ACTION OF SOLUBLE IODIDES ON STRYCHNINE SULPHATE.

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This investigation was brought about by the conflicting opinions in the literature found by the writer when gathering material for a course in incompatibilities in prescriptions.

The precipitation of strychnine and its salts by alkali iodides has been denied by some investigators and upheld by others. Furthermore, the precipitation has been said to be due to various causes, namely, alkalinity of the iodide, salting out of the strychnine salt, formation of the hydriodide and formation of a complex iodide.

Ruddiman (1) states that in some cases the precipitation is due to the alkalinity of the iodide. This view was also held by Campbell (2) and England (3).

Simon (4) added solutions of sodium chloride, bromide and iodide to solutions of salts of strychnine and obtained precipitates varying in degree in the order of the reagents named. He attributed the precipitation to the diminution of the solubility of the strychnine salts by the presence of the soluble inorganic salts.

The United States Dispensatory (5) states that strychnine should not be dispensed in liquid form with iodides for fear of forming the insoluble strychnine hydriodide.

The National Dispensatory (6) lists strychnine hydriodide as a salt sparingly soluble in cold water and dissolving more freely in alcohol. A method of preparation given is precipitation of the solution of strychnine salt by a solution of potassium iodide and recrystallization from alcohol.

Strychnine hydriodide is listed by Henry (7) and Allen (8) as sparingly soluble in water. It is not listed by any of the other later standard reference works such as the National Standard Dispensatory (9), Hager's "Handbuch" (10) and the United States Dispensatory (5).

The purpose of this investigation was to determine some of the conditions under which strychnine sulphate is precipitated by alkali iodides as well as the nature of the precipitation and the character of the precipitate formed.

EXPERIMENTAL.

A saturated solution of strychnine sulphate was treated with a 10% solution of potassium iodide, a white crystalline precipitate formed at once. An analogous reaction took place with sodium iodide.

It was thought that the precipitate formed might possibly be a double salt of strychnine sulphate and potassium iodide. The precipitate formed was washed thoroughly with distilled water, dried and tested qualitatively. A good test was obtained for strychnine and for iodine but the sulphate radical and potassium gave negative results. This indicated that the precipitate was strychnine hydriodide. It was recrystallized from diluted alcohol and the melting point taken. Above 275° it darkened and melted with decomposition above 280°. Because of the apparent decomposition that sets in at high temperatures it is impossible to obtain a definite melting point of the substance. The melting point varies according to the speed of heating of the bath, rapid heating giving a higher melting point with the same sample than slow heating.

A saturated solution of strychnine sulphate was treated with diluted hydriodic acid and a white crystalline precipitate was formed at once. It has the same appearance as the substance obtained with potassium iodide and showed the same behavior as to its melting point.

ANALYSIS OF STRYCHNINE HYDRIODIDE.

Sample 1.	0.500 Gm. required 10.45 cc. <i>N</i> /10 AgNO ₃ ≈ 26.52 per cent I
Sample 2.	0.500 Gm. required 10.5 cc. <i>N</i> /10 AgNO ₃ ≈ 26.64 per cent I
Sample 3.	0.500 Gm. required 10.4 cc. <i>N</i> /10 AgNO ₃ ≈ 26.39 per cent I
	C ₂ H ₂₂ N ₂ O ₂ ·HI·H ₂ O 26.50 per cent I

CONDITIONS OF PRECIPITATION.

Having determined the nature of the precipitation and the character of the precipitate a study was made of the conditions under which it takes place. In order to make the work of some practical significance, a dilution was chosen which would give an average dose of strychnine if it were prescribed in solution.

No.	Strychnine Sulphate.	KI.	H ₂ O q. s.
1	1 gr.	1.3	4 f $\overline{5}$
2	1 gr.	2.3	4 f $\overline{5}$
3	1 gr.	3.3	4 f $\overline{5}$
4	1 gr.	4.3	4 f $\overline{5}$
5	1 gr.	6.3	4 f $\overline{5}$
6	1 gr.	8.3	4 f $\overline{5}$
7	1 gr.	None	4 f $\overline{5}$

The above ingredients were compounded by dissolving the strychnine sulphate in half the water, adding the KI and then a sufficient quantity of distilled water to bring it up to the required volume. In Samples 1-6, inclusive, a white crystalline precipitate was formed a short time after mixing. This was identical with that formed with concentrated solutions of strychnine sulphate. There was no precipitation in the control even upon long standing. This series was repeated several times with the same results.

It was found that if the iodide were added to the strychnine salt in a smaller volume of water, a white crystalline precipitate was formed at once. This indicated that the controlling factor in this precipitation is the concentration of the strychnine salt. This was confirmed for when the quantity of strychnine sulphate was increased to two grains, a larger precipitate was formed at once with one dram of KI.

ESTIMATION OF THE SOLUBILITY OF STRYCHNINE HYDRIODIDE.

Rather than carrying out innumerable arbitrary concentrations, it was decided to estimate the solubility of the hydriodide in order to obtain an index as to the range of precipitation.

1. 100 cc. of saturated solution at 25° yielded 0.290 Gm. residue
 2. 100 cc. of saturated solution at 25° yielded 0.285 Gm. residue
 3. 100 cc. of saturated solution at 25° yielded 0.288 Gm. residue
- Average 0.287 Gm residue

This would give a solubility of 1 Gm. in about 345 cc. of water at 25°.

This solubility would indicate that strychnine hydriodide would not precipitate in the concentration given by the reaction of KI on one grain of strychnine sulphate in four fluidounces of water. It was found that the above solubility is greatly decreased by presence of excess of the soluble iodide, for when one dram of KI was added to four fluidounces of the saturated solution there was an immediate precipitation of the hydriodide. The influence of the iodides as well as other soluble compounds on the solubility of strychnine hydriodide is to be studied further in this laboratory.

FORMATION OF AN IODINE ADDITION PRODUCT.

Unless freshly boiled distilled water was used in making up the solution of strychnine sulphate and potassium iodide, the solution became yellow on standing,

due to the liberation of iodine, and the white crystalline precipitate was gradually changed over to one consisting of brownish red needles.

This reaction was greatly accelerated when the solution was slightly acidified.

The precipitate was collected and recrystallized from alcohol in which it is only sparingly soluble. It melted at 252–254° with decomposition. When the melting point bath was slowly heated decomposition set in at a lower temperature and the melting point was lowered. The appearance and melting point indicated that the substance was the periodide $C_{21}H_{23}O_2N_2I_3$ which was prepared by Bura-czewski and Kozniewski (11) from a di-iodo derivative obtained by precipitating a hot alcoholic solution of strychnine with a concentrated solution of iodine in carbon disulphide.

This was confirmed by analysis.

1.000-Gm. sample required 41.6 cc. $N/10$ $AgNO_3 \approx 52.78$ per cent I

0.875-Gm. sample required 36.5 cc. $N/10$ $AgNO_3 \approx 52.90$ per cent I

$C_{21}H_{23}O_2N_2I_3$ equals 53.01 per cent I

Strychnine periodide is practically insoluble in water and only sparingly soluble in alcohol.

SUMMARY.

1. Strychnine hydriodide is formed when strychnine sulphate solutions are treated with alkali iodides or hydriodic acid.
2. One gram of strychnine hydriodide is soluble in about 345 cc. of water at 25°. This solubility is greatly decreased by the presence of excess soluble iodide.
3. Strychnine periodide is formed when a very dilute solution of iodine reacts on strychnine hydriodide. This substance has a low solubility in both water and alcohol and adds to the danger of prescribing strychnine in solution with iodides.

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