THE SELECTION OF GLASS FOR THE MANUFACTURE OF AMPULS.*

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THE selection of and requirements for glass bottles for storing the ordinary elixirs, fluidextracts, powders, tablets, etc., employed in pharmacy is a crude process, indeed, in comparison with the careful tests required for the selection of a proper glass for the manufacture of ampuls. This care is necessitated by reason of the fact that unselected glass may possess sufficient free alkali, or may be capable of yielding sufficient free alkali under the stress of the sterilization process which ampul solutions are required to undergo, or may yield sufficient alkali in the period during which they are necessarily kept in stock before being sold, to cause the precipitation of a portion of the alkaloidal base of a solution of alkaloidal salt when placed in the ampuls, and because unselected glass may throw off spicules or splinters of glass under the stress of the sterilization process or during storage. It is sufficient merely to point out, in order to show the unsuitability and even danger in the use of improperly selected glass, that precipitation of alkaloidal base will result in the lowering of the efficacy of an ampul solution upon which a physician may be relying in a serious case of illness and the production of spicules or splinters of glass in the ampul solution may result in discomfort, local irritation, or possibly more remote and more dangerous consequences. The use of a slight addition of acid to ampul solutions in an effort to correct for the alkalinity of unselected or improperly selected glass is contra-indicated in view of the fact that glass can be made or selected which requires no use of acid. The use of acid is also contra-indicated because acidity is usually productive of irritation at the site of injection.

In outlining tests for the selection of glass for the manufacture of ampuls the working of the glass under the flame must also be considered. In addition, other tests which may act as checks on the "alkalinity," "spicule" and "flame" tests are

* Communicated by the Author.

frequently resorted to. The series of tests mentioned below will, as a rule, be sufficient for proper selection of glass, if applied "secundum artæ." However, the "art," particularly the "flame" testing can be attained only by practical experience.

TESTS FOR THE SELECTION OF GLASS FOR THE MANUFACTURE OF AMPULS.

Size of tubing, thickness of wall, freedom from certain proscribed ingredients, color: in accordance with specifications.

"Working under the flame": can be judged only by practical experience obtained by comparison of many varieties of glass.

Standard: greatest ease in working consistent with the other requirements.

"Alkaloidal Alkalinity Test"—"General."—A 1 per cent. solution of U. S. P. morphine sulphate or a 0.2 per cent. solution of U. S. P. strychnine sulphate in normal saline solution must not develop crystals or become turbid or opalescent when sterilized under practical conditions in ampuls made from the glass undergoing test; the ampuls having been treated with dilute hydrochloric acid and finally thoroughly washed free from acid and dried before the alkaloidal solution is placed in them. The preferred test is the "particular" one which is in all respects similar to the "general" test except that the particular solution which is intended to be marketed in the ampuls is used in place of the morphine sulphate or strychnine sulphate solutions.

"Spicule Test."—Work the glass into ampuls. Place a 0.6 per cent. NaCl solution (or any particular solution) in the ampuls; seal and sterilize under practical conditions. The solution is then carefully examined under a magnifying glass for spicules or splinters of glass.

Exact conformity with the above tests is absolutely necessary in order to permit the use of any particular glass for the manufacture of ampuls.

The following tests are applicable for comparative purposes only, and are occasionally employed as confirmatory checks:

"Phenolphthalein Alkalinity Test."—Treat the glass with dilute HCl followed by very thorough washing. Boil a sample corresponding to 500 sq. centimetres of surface for 16 hours with distilled water, keeping the sample covered with fresh additions of water as required. Remove the glass, add 1 c.c. phenolphthalein test solution to the water in which the glass was boiled

and titrate to neutrality. Make a correction on the water, vessel in which the boiling was conducted, locality in which the test was carried out, etc., by running a blank under precisely the same conditions employed in making the test, and at the same time. Report alkalinity as milligrams of NaOH per 100 sq. cm.

"Loss to Water Test."—The sample used in the "phenolphthalein alkalinity test" is weighed before and after boiling. Report loss as milligrams per 100 sq. cm.

"Vulnerability to Alkaline Fluids Test."—Repeat the "loss to water test," using a new sample and using 2 per cent. sodium carbonate solution in place of water, keeping up the volume by fresh additions of water only. Report loss as milligrams per 100 sq. cm.

"Phenolphthalein Alkalinity Autoclave Test."—Water containing a few drops of phenolphthalein test solution is placed in the ampul (which has previously been acid-washed and thoroughly rinsed with distilled water); the ampul is sealed and autoclaved at 12 lbs. steam pressure for 45 minutes. At the end of this time the tube is carefully examined for color and spicules. A pink color indicates alkalinity.

"Phenolsulphonephthalein Alkalinity Autoclave Test."—In all respects this is similar to the preceding test with the exception that a yellowish solution of phenolsulphonephthalein is used instead of phenolphthalein and the autoclaved liquid is examined for any reddish tint which may develop.

The following table shows some typical results obtained by the use of the several tests mentioned above in glass tubing offered for the manufacture of ampuls:

Sample No.	Color.	"Flame" test.	"Spicule" test.	"Phenolphthalein Alkalinity" test.	"Loss to Water" test.	Suitability.
1	Flint	O. K.	None	0.098 mgm.	0.7 mgm.	O. K.
2	Flint	Works hard	Spicules	.....	4.2 mgm.	Not O. K.
3	Flint	Works easily	Spicules	.....	1.9 mgm.	Not O. K.
4	Flint	Works easily	None	Undeter. trace	0.61 mgm.	O. K.
5	Flint	Works easily	None	0.102 mgm.	1.1 mgm.	O. K.
6	Flint	Works hard	Spicules	.....	Unweighable	Not O. K.
7	Flint	Works easily	None	.....	0.62 mgm.	O. K.
8	Flint	Works easily	None	.....	0.49 mgm.	O. K.
9	Flint	Works easily	None	.....	3.2 mgm.	O. K.
10	Flint	Works easily	A few spicules	.....	4.4 mgm.	Not O. K.

All of these samples yielded perfect results in the "alkaloidal alkalinity" test. As a matter of fact, after a satisfactory source has been established, it is only occasionally that a sample fails to answer this requirement, but this occasional exception illustrates the necessity for the application of this test.

The relation between the alkalinity yielded in the "phenolphthalein alkalinity" test and the result of the "alkaloidal alkalinity" test was not determined, the "phenolphthalein alkalinity" test being rejected in favor of the shorter and more practical "alkaloidal alkalinity" test.

The phenolphthalein and phenolsulphonephthalein alkalinity autoclave tests are used by some workers, but they are open to the criticism that they bear no practical direct relation to the possible use of the glass for ampul purposes, whereas in the same time and with no more labor a direct result can be obtained by the use of the "alkaloidal alkalinity test."

No definite information can be obtained regarding the possible formation of spicules by a glass, from its working qualities under the flame. In the experience of some workers, the hard glasses appear to suffer surface scaling under the influence of the moisture and heat used in autoclaving, whereas in the experience of others, the more easily worked and more soluble glasses yield spicules by surface erosion due to solution of the alkaline radicle of the glass.

The results yielded by the application of the "phenolphthalein alkalinity," "loss to water" and "vulnerability to alkaline fluids" tests to some samples of glass tubing, bottles, Erlenmayer flasks, test tubes and beakers are herewith appended as a matter of comparison and of interest:

Sample.	Color.	"Phenolphthalein Alkalinity" test.	"Loss to Water" test.	"Vulnerability to Alkaline Fluids" test.
Tubing	Flint	Undeterminable trace	Unweighable	21.0 mgm.
Tubing	Flint	Undeterminable trace	1.5 mgm.	.....
Tubing	Flint	Undeterminable trace	Unweighable	30.0 mgm.
Tubing	Flint	.....	1.17 mgm.	.....
Tubing	Flint	Undeterminable trace	Unweighable	24 mgm.
Tubing	Flint	Undeterminable trace	Unweighable	8.25 mgm.
Tubing	Flint	.....	1.2 mgm.	.....
Tubing	Flint	.....	4.0 mgm.	22.5 mgm.
Tubing	Flint	.....	2.5 mgm.	43.5 mgm.
Tubing	Flint	.....	0.62 mgm.	.....
Tubing	Flint	.....	2.5 mgm.	31.5 mgm.
Tubing	Flint	.....	3.0 mgm.	27.5 mgm.
Tubing	Flint	.....	3.1 mgm.	.....
Tubing	Flint	.....	3.5 mgm.	24.0 mgm.
Tubing	Flint	.....	Unweighable	9.25 mgm.
Tubing	Flint	Undeterminable trace	Unweighable	6.5 mgm.
Tubing	Flint	.....	Unweighable	20.0 mgm.
Tubing	Flint	.....	Unweighable	17.5 mgm.
Tubing	Amber	.....	Unweighable	2.65 mgm.
Tubing	Amber	.....	Unweighable	2.0 mgm.
Tubing	Amber	.....	8.0 mgm.	56.5 mgm.
Tubing	Amber	.....	1.5 mgm.	22.5 mgm.
Tubing	Amber	.....	3.0 mgm.	27.5 mgm.
Tubing	Amber	.....	4.0 mgm.	19.0 mgm.
Tubing	Amber	.....	5.0 mgm.	12.5 mgm.
Tubing	Amber	.....	8.0 mgm.	25.0 mgm.
Tubing	Amber	.....	10.0 mgm.	57.5 mgm.
Tubing	Amber	.....	Unweighable	7.5 mgm.
Tubing	Amber	.....	Unweighable	7.8 mgm.
Tubing	Blue . . .	.....	0.15 mgm.	1.8 mgm.
Bottle	Flint	.....	0.45 mgm.	.....
Bottle	Flint	.....	0.59 mgm.	.....
Bottle	Flint	.....	0.39 mgm.	.....
Erlenmayer flask	Flint	.....	0.0107 mgm.	.....
Test tubes . .	Flint	Undeterminable trace	0.28 mgm.	.....
Beaker	Flint	Undeterminable trace	3.0 mgm.	.....
Beaker	Flint	.....	Unweighable	3.3 mgm.
Beaker	Flint	Undeterminable trace	Unweighable	18.5 mgm.
Beaker	Flint	Undeterminable trace	Unweighable	13.0 mgm

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