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MERCURY CONTENT OF SILVER AMALGAM

INFLUENCE OF TIME BETWEEN COMPLETION OF THE MIX AND START OF CONDENSATION

by

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It is generally known that triturated silver amalgam will absorb more and more mercury the longer it is left to stand after mixing is completed. The progressive absorption of mercury by the amalgam is manifested by a gradual loss in plasticity with decrease in the amount of mercury expressed during condensation. It is also known that the mercury content of a hardened amalgam filling determines, to a considerable degree, the strength of the filling: the less mercury (up to a certain limit), the greater strength.

In order to examine the rate at which mercury is absorbed by various brands of amalgam alloy the following investigation was performed.

METHODS

Proportioning and mixing of amalgam alloy and mercury were carried out as directed by the manufacturers. For determination of the mercury content both alloy and mercury were weighed (maximum inaccuracy, 0.5 mg) before trituration. The mix was then transferred to a cylindrical steel mold (Fig. 1) with an internal diameter of 5 mm, in which it was condensed with a lower and an upper piston of the same diameter as that of the mold. The time at which condensation was started was varied systematically for each brand of alloy. For all brands the earliest condensation could begin ½ minute after the mix was completed.

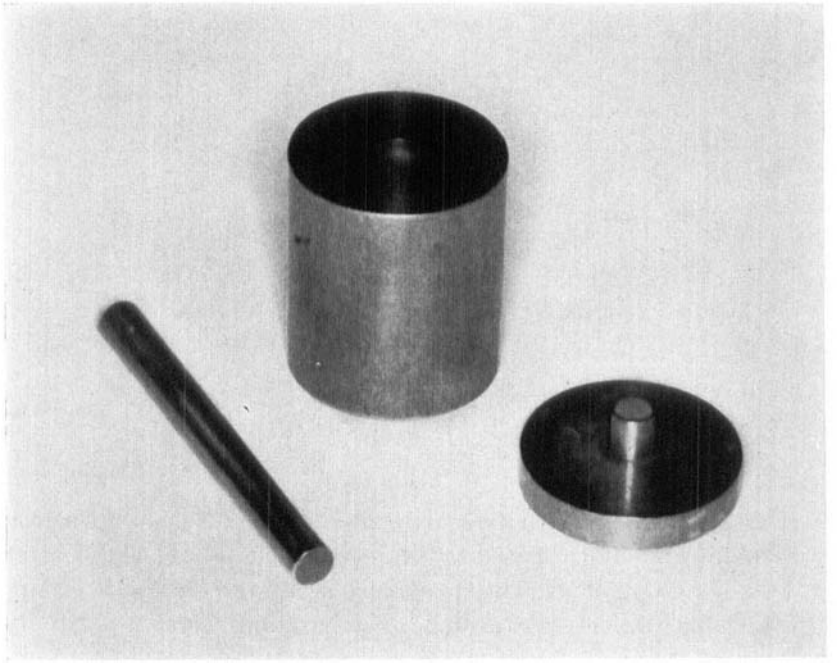

Fig. 1. Cylindrical steel mold with upper and lower piston used for the preparation of test specimens.

The condensation was effected by means of an Alfa Durometer (Figs. 2 and 3) provided with a dial gauge which recorded the downward movement of the piston in the mold. Condensation was terminated when the dial gauge had not registered any movement of the piston for a period of 5 minutes. A pressure of 40 kg was applied in all the tests. The mix was in each case of a size to give the test specimens a length of approximately 10 mm. The expressed mercury was collected and weighed, after which it was possible to compute the percentage content of mercury in the test specimens. The calculation was based on the assumption that the expressed mercury was pure, but the error introduced by this approximation was neglible, since analyses by distillation showed relatively little contamination of the mercury (not above 5 % of the total weight of liquid metal expressed).

The brands used in the investigation are listed in Table I. Alloys Nos. 3, 4, 6, and 7 are pre-amalgamated.

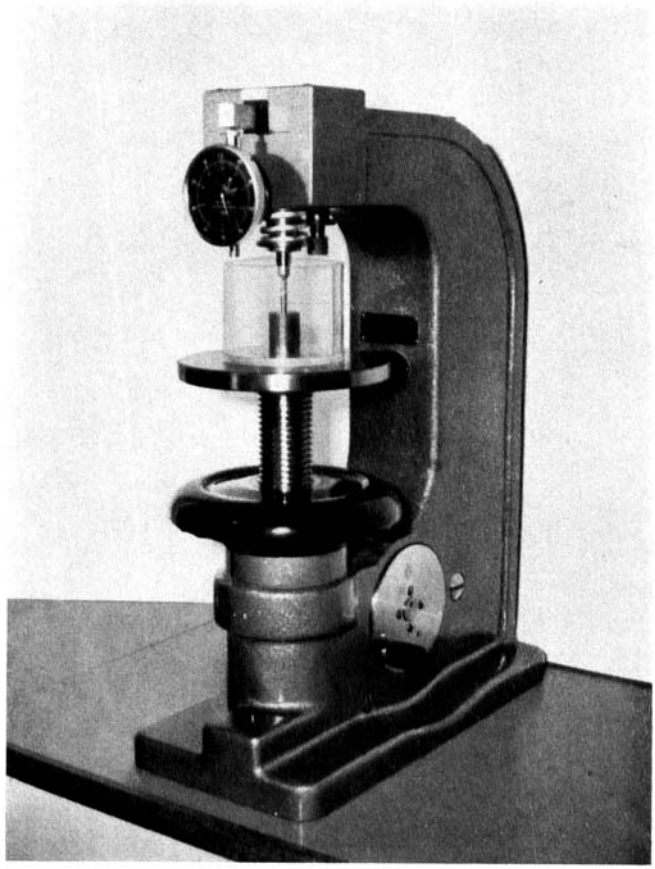

Fig. 2. Alfa Durometer used for condensation of the amalgam test specimens.

Table I.

No.	Brand	Manufacturer
1	True Dentalloy	S. S. White Denta Mfg. Co (G. B.)
2	New True Dentalloy	» » » »
3	STA 68	Guldsmeds Aktiebolaget i Stockholm, G. A. B.
4	Standalloy	Degussa
5	DAB Standard	AB Svenska Dental Instrument
6	DAB Argos	» » »
7	DAB Argos Non-zink	» » »

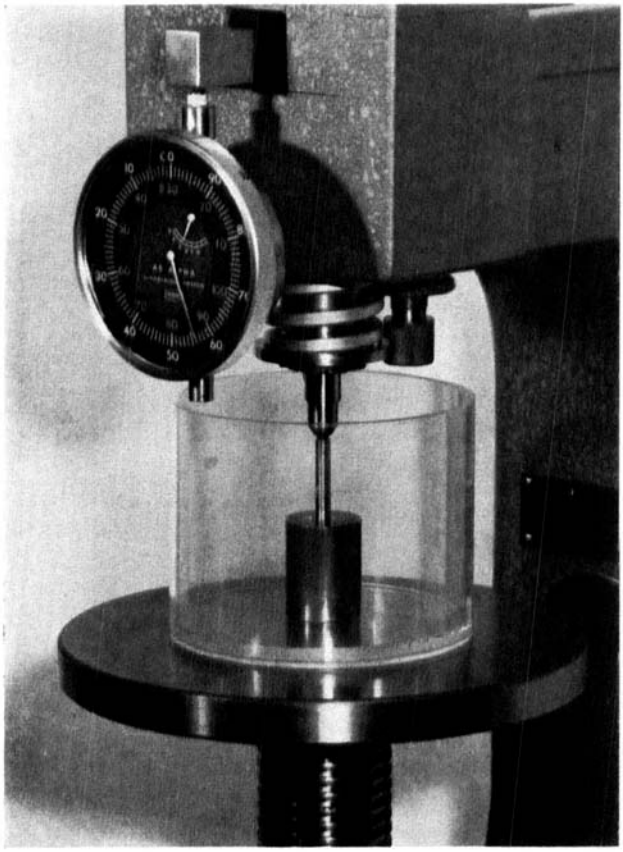

Fig. 3. Test mold with pistons mounted on Alfa Durometer. The mold is placed in a flat-bottomed dish of plexi-glass for collection of expressed mercury.

RESULTS

For each brand three tests were generally carried out for the individual starting times of condensation. For alloys Nos. 1 and 2, however, five tests were made in order to examine the variance of the findings, while with alloys Nos. 3 and 4 only two tests were conducted for each condensation time. Table II shows highest, lowest, and mean values obtained with brand No. 1 for the individual condensation times. Table III gives mean values for all the tests. The latter are presented graphically in Fig. 4.

Table II.

Percentage mercury content of test specimens from brand No. 1.

Time of start of condensation, minutes	½	1	2	3	4	5	7	9	11	15	19	23	27
Minimum	46.7	46.2	46.7	46.4	47.7	48.2	49.8	50.0	52.2	53.8	54.7	55.9	55.0
Maximum	47.8	48.6	47.8	47.6	48.2	49.8	50.9	52.6	53.7	56.0	56.7	57.8	57.6
Mean value	47.2	47.0	47.2	47.1	47.9	48.9	50.1	51.6	53.0	54.9	56.0	56.6	56.4

Table III.

Percentage mercury content of test specimens of all the brands. Mean values.

	½	1	2	3	4	5	7	9	10	11	15	19	20	23	27	40
Brand 1	47.2	47.0	47.2	47.1	47.9	48.9	50.1	51.6		53.0	54.9	56.0		56.6	56.4	
2	45.1	45.7	46.4	47.7	48.2		50.9			53.2	56.0	56.7		57.7		
3	37.7	36.3		37.4		39.0			40.2				43.0			49.7
4	36.3	35.3				38.0			40.5				45.1			49.5
5	49.4	49.2				51.7			55.8				57.8			
6	42.9	43.3				45.2			46.4				50.2			
7	44.1	44.7				47.6			48.0				53.6			53.3

For all the brands the tests appearing last in the tables and in the diagram were carried out just at the time when it was no longer possible to express excess mercury. The time for the last experiment in a series was established, inter alia, by measuring for how long a time after start of an expression test the dial gauge of the Durometer continued to show escape of mercury.

DISCUSSION

The experimental results show that there may be great differences in the mercury content of test specimens made with identical technique from different brands. For condensation started ½ minute after the mix was completed the brand with the highest amount of mercury contains 49.4 %, while the brand with the lowest mercury content only shows 36.3 %. It is also noteworthy that the rate at which mercury is absorbed by the alloy, as expressed by the slope of the curves in Fig. 4, shows appreciable differences. Brand No. 6, for example, is much slower than brand No. 2.

Brands Nos. 3 and 4 are probably identical though they have different trade names.

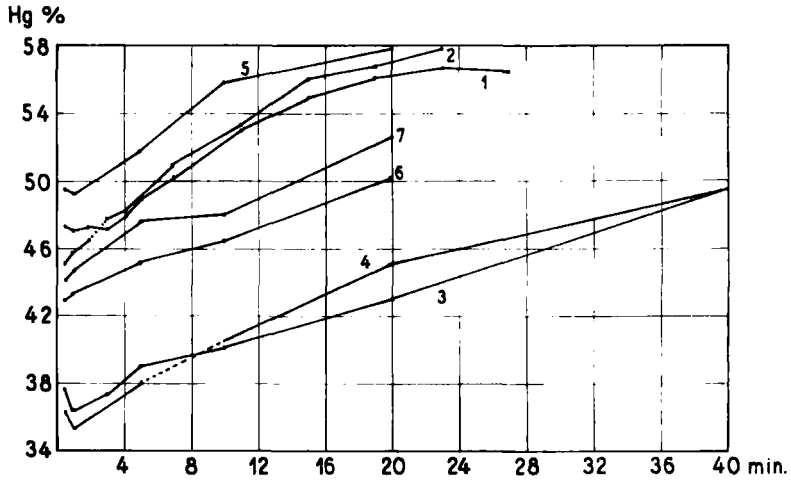

Fig. 4. Relation between the mercury content of the various alloy brands and the time of start of condensation reckoned from completion of the mix. The numbers of the brands refer to Table I.

The pronounced differences in mercury content between test specimens from the various brands may tempt to assume corresponding differences in the physical and mechanical properties of the set amalgams. Such an immediate inference, however, is not warranted. According to preliminary studies, amalgam prepared in the same manner from different brands may possess about the same compressive strength, even if they differ considerably in mercury content. The crushing strength of amalgams from the same brand of alloy, on the other hand, can no doubt be assumed to decrease with increased mercury content. The relation between these two factors is being studied in our department.

The cause of the differences demonstrated between the various brands with regard to retained mercury is not immediately apparent from the tests. There is, however, reason to point out that elastic and plastic properties as well as particle shape and grain size distribution must be factors of decisive importance. Test specimens from the pre-amalgamated — and therefore probably rather soft — alloys Nos. 3, 4, 6 and 7 are all characterized by a relatively low content of mercury.

SUMMARY

This is a study of the relation between the mercury content of amalgam specimens and the start of time of condensation reckoned from completion of the mix. The results are presented in Table III and Figure 4.

So far, the clinical significance of the differences between different brands and different starting times is obscure. Further studies are being performed to clarify this problem.

RÉSUMÉ

TENEUR EN MERCURE DE L'AMALGAME D'ARGENT: INFLUENCE DU TEMPS ÉCOULÉ ENTRE LA TERMINAISON DU MÉLANGE ET LE DÉBUT DE LA CONDENSATION

La présente étude concerne le rapport existant entre la teneur en mercure de spécimens d'amalgame et le délai du début de la condensation à compter du moment de la terminaison du mélange. Les résultats sont présentés sur le tableau III et la fig. 4.

Jusqu'à présent, la signification clinique des différences entre diverses marques et entre différents délais de début de condensation reste obscure; des études complémentaires sont en cours pour élucider ce problème.

ZUSAMMENFASSUNG

DER QUECKSILBERGEHALT DES SILBERAMALGAMS IN ABHÄNGIGKEIT DES BEGINNENS DER KONDENSATION NACH DEM ANRÜHREN

Es wird eine Untersuchung beschrieben über den prozentualen Quecksilbergehalt in Amalgamprüfkörpern, hergestellt aus verschiedenen Alloy-Erzeugnissen, wenn die Kondensation zu verschiedenen Zeitpunkten nach dem Anrührbeginn angefangen wird. Die Ergebnisse gehen aus der Tabelle III und dem Diagramm Abb. 4 hervor. Deutliche Unterschiede zwischen den Erzeugnissen lassen sich erkennen. Die Bedeutung dieser Unterschiede ist noch zum Teil unklar.

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