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AGING OF THE ZINC ALLOY TsAM 4-1

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The dimensions of pressure die castings in zinc-base alloys change in the course of time because of natural aging. We have studied the effects of natural and artificial aging and sub-zero treating on the dimensions of such castings and have determined aging conditions for the alloy TsAM 4-1 (3.5-4.5% Al, 0.5-1.5% Cu, bal - Zn).

Specimens measuring 6.5 x 6.5 x 50 mm (1/4 x 1/4 x 2 in) were cast on a Pollak machine, ground and lapped. Measurements were made in the plant laboratory on a horizontal [Zeiss] optimeter (IGK) with 0.01 mm scale divisions. Two batches of specimens, cast 6 months apart, were naturally aged. Measurements were made two days after casting, then every seven days the first month, and later once or twice a month. The natural aging period was 450 days for the first, and 180 days for the second, batch.

Artificial aging was conducted at 80, 100 and 120°C (175, 210 and 250°F) for 3-24 hours.

Subzero treatment was carried out at -20 to -70°C (-4 to -84°F) for four months.

Since most zinc-base castings are oxidized in solutions of chromium compounds, the effect of such treatment on their dimensions was studied, both immediately after casting and after aging. The oxidizing treatment was the standard one employed at the factory, with preliminary degreasing in soda solution at 80-90°C (175-195°F) for 2-3 minutes.

From Fig. 1 it will be seen that during natural aging, there is a rapid contraction in the first month, which then slows down and after 45 days when the decrease is about 0.1%, it practically ceases.

Fig. 2 shows that in artificial aging, at all temperatures, there is the same 0.12-0.14% decrease in dimensions in the first six hours of aging, after which there is no further change.

In separate artificial aging tests at the same temperatures, but for six hours only, blisters appeared at 120°C (250°F) in light-section castings, so that artificial aging at this temperature cannot be recommended.

The decrease in dimensions in sub-zero treatment varied from 0% after 12, to 0.036% after 120 days, indicating that this treatment retards the aging of the alloy, because after 120 days of natural aging, the decrease was 0.1%.

Oxidizing the alloy immediately after casting decreases its dimensions by 0.03%. In a repeated oxidation, the shrinkage reaches 0.085%. Natural or artificial aging of the same specimens causes a further fall in dimensions up to 0.12%, as occurs in specimens not subjected to an oxidizing treatment.

There is no dimensional change in aged specimens during oxidation.

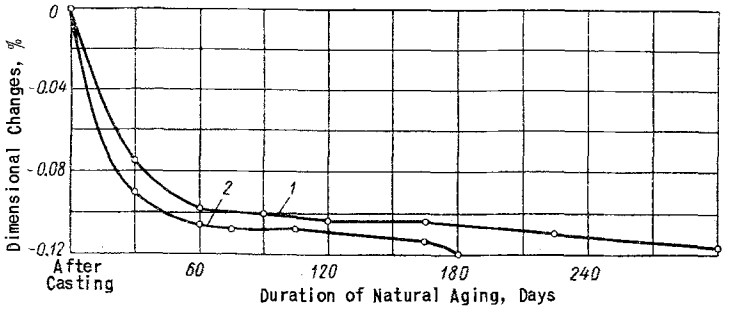

Fig. 1. Dimensional changes of specimens of zinc alloy during natural aging. 1 = first batch; 2 = second batch.

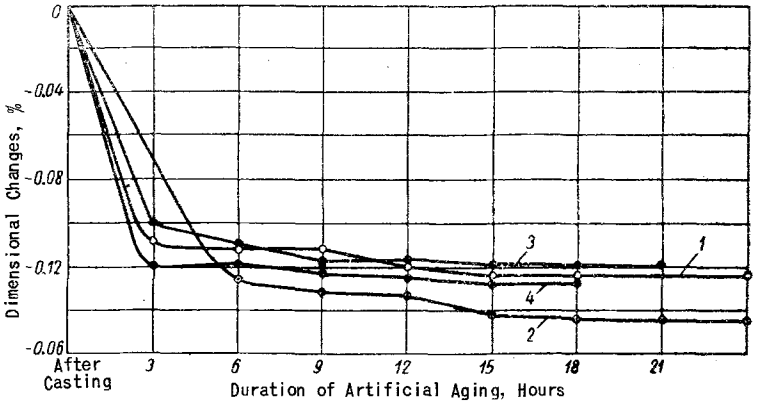

Fig. 2. As Fig. 1, but for artificial aging. 1 = 80°C (175°F) first batch; 2 = 80°C, second batch; 3 = 100°C (210°F); 4 = at 120°C (250°F).

CONCLUSIONS

1. Natural and artificial aging cause approximately the same linear contractions in specimens of zinc alloy TsAM 4-1. Sub-zero treatment retards the change.
2. 450 days' natural aging of castings causes their dimensions to decrease by 0.11-0.12%, mostly in the first month; the shrinkage is eventually complete in 45 days.
3. There is a 0.12-0.14% decrease in dimensions of specimens in the first six hours of aging at 80-120°C (175-250°F) with no later changes.
4. It is recommended that castings of this alloy, for which the tolerances are particularly close, should be naturally aged for 45 days or artificially aged for six hours at 80-100°C (175-210°F).
5. Oxidizing the alloy immediately after casting decreases its dimensions by 0.03% but causes no change of dimensions in castings already aged.