WATER CANS

PRELIMINARY REPORT OF TESTS ON WATER CANS,
5 GALLON; GALVANIZED.

1. Physical Condition of Cans.

Upon receipt the six cans were all dull dark gray on the outside, the result of a "pickling" process.

Three of the cans were "pickled" on the inside as well; the other three showed the bright finish and characteristic rosette appearance of galvanizing.

Caps on all cans were "frozen" and difficult to remove. Evidence of corrosive action on the threads of cap and nipple was present.

A white powdery coating varying from slight to heavy was present in all cans. In some large flocs of whitish precipitate were adherent to the walls.

Prior to any testing, the cans were thoroughly scrubbed with calgonite and hot water, using brushes with hair or fiber bristles only. After each succeeding use, the cans were similarly scrubbed.

The cans could not be completely drained because of the inward directed threaded nipple. Approximately three ounces (85 to 95 cc) of water remained after the most complete emptying possible. To facilitate complete drainage a ½ inch hole was bored through the top of the can just at the shoulder below the regular opening.

2. Analysis of base metal and coating.

a. Base metal - low carbon steel

b. Coating - physically stripped from a can, the top of which was sawed off:

Zinc	95.3 %
Iron	2.9
Lead	1.03
Antimony	0.23
Total recovery	99.46%

3. Change in reaction of waters in the cans.
(All pH determinations made electrometrically)

a. Distilled water - preliminary test.

Time in can	pH
Initial	3.4
After 1 min.	6.0
" 18 hrs.	8.6
" 24 hrs.	8.6

Time in can	pH
After 48 hrs.	8.8

c. Distilled water - collected directly from still with soda lime connections to exclude CO_2 from air.

Initial	5.4
After 1 min.	5.6
" 24 hrs.	7.9
" 48 hrs.	8.6

In the above three runs, 6 liters of water used each time. The cans were allowed to stand, without shaking, at room temperature. Only in (3) was any attempt made to exclude CO_2.

d. Further definitive determination of pH was made for the purpose of correlating reaction with solution of the coating metal. The waters used, time elapsing and pH are shown in the table below:

Change in pH

Can "C" - Distilled Water		Can "D" Tap Water		Can "C" Distilled water & 1 PPM Chlorine		Can "A" Tap water & 1 PPM Chlorine	
Elapsed Time	pH	Elapsed Time	pH	Elapsed Time	pH	Elapsed Time	pH
Initial	5.7	Initial	7.9	Initial	6.6	Initial	7.85
*Immediate	6.0	*Immediate	8.0	*Immediate	6.85	*Immediate	8.00
2 Min.	6.05	15 Min.	8.15	15 Min.	7.0	15 Min.	8.10
6 Min.	6.10	30 Min.	8.25	30 Min.	7.2	30 Min.	8.15
10 Min.	6.15	150 Min.	8.25	45 Min.	7.2	1 Hr.	8.15
18 Min.	6.40	4½ Hrs.	8.40	75 Min.	7.2	4 Hrs.	8.25
26 Min.	6.40	24 Hrs.	8.75	105 Min.	7.25	6 Hrs.	8.30
42 Min.	6.50			24 Hrs.	8.25	24 Hrs.	8.45
74 Min.	6.50						
138 Min.	6.60						
266 Min.	6.60						
24 Hrs.	7.15						

* Immediate means that a sample was withdrawn as soon as possible after introducing the water into the can.

In all instances 10 liter quantities were used and prior to sampling the cans were vigorously shaken in addition to being shaken at intervals during the test in order to reduce the amount of CO_2 in solution.

4. Evidence of chemical action on coating metal.

a. Distilled water - not chlorinated. After 24 hours the water was very faintly milky with flocs of a heavier sediment which adhered to the sides of a glass vessel. Patches of white deposit could be seen in the can.

b. Tap water - not chlorinated. After 24 hours the water was very milky and contained a white sediment in particles of varying size. Inside of can showed many patches of white deposit.

after 24 hrs. with a considerable amount of heavy white precipitate.

d. Tap water, chlorinated, 1 PPM. Free chlorine disappears rapidly. (See table). Water very cloudy after 24 hours, with large amount of heavy white sediment.

In the four tests above, it was observed that the portion of the can covered by water was distinctly warmer than the metal above the water level. This would indicate an exothermic reaction, probably galvanic in nature.

Upon opening the cans there was a musty, metallic odor and the waters all had a distinctly metallic taste.

5. Loss of free chlorine - Remaining concentration in PPM.

Can	Run	Water	Time in Minutes						
			Initial	5	10	15	30	60	150
A	1	Distilled	1.0	0.5	0.4	0.25	0.1	0.05	0.0
A	2	"	0.5		0.1		0.05		0.0
A	3	"	0.3	0.15	0.15	0.1	0.1	0.02	0.0
B	1	"	1.0	0.5	0.4	0.3		0.1	0.0
B	2	"	0.5		0.1		0.05		0.0
B	3	"	0.3	0.2	0.15		0.1		0.0
F	1	Tap	0.5	0.2	0.1	0.1		0.05	0.0
F	2	"	0.2	0.1	0.05		0.0		

In can "B" some of the base metal was exposed due to breaking of "blisters" of the coating metal. As soon as base metal (iron) is exposed a galvanic action is set up and the typical moth eaten appearance is produced, followed by rapid rusting of the base metal.

Can "A" showed no visible breaks in coating.

Can "C" is one from which the top was cut upon receipt and from which coating metal was stripped for analysis. Using a dental abrasive disc, the coating was removed from four circular areas on the bottom of the can, each $\frac{1}{4}$ inch in diameter, to set up an artificial condition such as later occurred spontaneously in can "B".

6. Zinc content of water from cans.

Quantitative determinations of zinc, lead and total solids are not yet completed, but qualitative tests show that zinc is dissolved from the galvanized lining by distilled water, plain and chlorinated, and by tap water, plain and chlorinated.

7. Conclusions.

a. Water, chlorinated or unchlorinated, after storage for 24 hours in the galvanized water cans is unpalatable in appearance and taste. This is due in part to the actual solution of zinc by the water and in part to the

resultant precipitation from solution of calcium and magnesium salts naturally present.

b. No conclusions as to the effect on the health of individuals consuming such water can be drawn at the present time. However, should lemonade, or other mildly acidic beverage be placed in such cans, sufficient zinc would be put into solution to produce severe symptoms of gastro-enteritis in individuals using the beverage.

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