

*File*

# FILE COPY

O T T A W A

November 30, 1945.

## R E P O R T

of the

### ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1972.

Resistance of Various Metals to Corrosion by  
Molten Salt and Aqueous Salt Solution.



O T T A W A

November 30, 1945.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1972.

Resistance of Various Metals to Corrosion by  
Molten Salt and Aqueous Salt Solution.

=====

Background:

An inquiry was received as to the best metal for resisting the corrosion of molten salt (sodium chloride). It was claimed that pans made of ordinary cast iron were not sufficiently resistant to the action of this material.

On inquiry it was found that occasionally the plant in which the salt was melted remained idle for some time. During that period, undoubtedly, the pans would be corroded by a saturated, or at any rate concentrated, aqueous solution of the salt.

Accordingly, samples of metals which would be most likely to resist the corrosion of both molten salt and the concentrated salt solution were obtained.

INVESTIGATION:

The corrosion resistance of the following metals was compared:

1. Cast iron, taken from one of the pans used at the plant at the present time.
2. Nickel.
3. Inconel.  
(Nickel, 78.5 per cent; chromium, 14.0 per cent; iron, 6.5 per cent).
4. Ni-Resist, copper-containing.  
(Nickel, 14 per cent; copper, 6 per cent; chromium, 2 per cent; balance iron).
5. Ni-Resist, copper-free.  
(Nickel, 20 per cent; chromium, 2 per cent; balance, iron).
6. Stainless steel.  
(Chromium, 18 to 20 per cent; nickel, 8 to 10 per cent; molybdenum,  $2\frac{1}{2}$  to 3 per cent).

Test No. 1.

After weighing, samples of the above metals were placed in a cast iron pan and molten salt, obtained from the plant, was poured on them. The solid chloride was removed and the molten material was again poured on the samples. This procedure was repeated until sixteen pourings had taken place. The samples were reweighed. Then the molten salt was poured on them fourteen more times and they were weighed again. The results are given in Table I. No attempt was made to remove the adherent scale before the corroded samples were weighed.

(Table I follows,  
on Page 3.)

(Investigation, cont'd) -

TABLE I.

Metal	Average Penetration Per Pouring (inches).	
	After 16 Pourings	After 30 Pourings
Cast iron	0.0000034	0.0000051
Nickel	0.0000004	0.0000003
Inconel	0.0000007	0.0000004
Ni-Resist (copper-containing)	0.0000009 <sup>⊕</sup>	0.0000003 <sup>⊕</sup>
Ni-Resist (copper-free)	0.0000006 <sup>⊕</sup>	0.0000005 <sup>⊕</sup>
Stainless steel	0.0000015	0.0000015

<sup>⊕</sup> These figures indicate gain in weight.  
All other figures indicate loss in weight.

Test No. 2.

After the samples had been exposed to the thirty pourings of molten salt they were placed in the Rapid Intermittent Immersion Corrosion Test for 7 days. The corroding liquid was a saturated aqueous salt solution and the temperature was about 95° F. Any adhering scale from the former test was allowed to remain on the samples during this test. The results are given in Table II.

TABLE II.

Metal	Average Penetration Per Day (inches)
Cast iron	0.000029
Nickel	0.0000002
Inconel	0.0000002
Ni-Resist (copper-containing)	0.0000074
Ni-Resist (copper-free)	0.0000059
Stainless steel	0.0000008

(Investigation, cont'd) -

Test No. 3.

Samples of fresh metal were placed in the Rapid Intermittent Immersion Corrosion Test for 21 days. The conditions of the test were the same as in Test No. 2. The results are given in Table III.

TABLE III.

Metal	Average Penetration Per Day (inches)
Cast iron	0.00003
Nickel	0.0000002
Inconel	0.0000002
Ni-Resist (copper-containing)	0.0000067
Ni-Resist (copper-free)	0.0000063
Stainless steel	0.00000006*

\* All of the rust visible on this material was located at the hole which was drilled at one end for suspension.

CONCLUSIONS:

The metals are arranged in order of preference in Table IV.

TABLE IV. - Order of Preference

Order	M E T A L	
	In Fused Salt	In Saturated Salt Solution
1 (best)	Ni-Resist (copper-free)	stainless steel
2	Ni-Resist (copper containing)	Nickel ) ) equal
3	Nickel	Inconel)
4	Inconel	Ni-Resist (copper-free)
5	Stainless steel	Ni-Resist (copper containing)
6 (worst)	Cast iron	Cast iron.

oooooooooooo  
ooooooo  
oo