UNCLASSIFIED

NYO-5129

METALLURGY AND CERAMICS

0

UNITED STATES ATOMIC ENERGY COMMISSION

CORROSION TESTS ON STEELS IN AAA
[PITCHBLEND] LIQUORS

By
T. C. Furnas

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission to the extent that such employee or contractor prepares, handles or distributes, or provides access to, any information pursuant to his employment or contract with the Commission.

June 26, 1945

Mallinckrodt Chemical Works
St. Louis, Missouri

Technical Information Service Extension, Oak Ridge, Tenn.

This document is
PUBLICLY RELEASABLE
JRO Review Team
Authorizing Official
Date 11-9-2010

UNCLASSIFIED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

CORROSION TESTS ON STAINLESS STEELS IN AAA [PITCHBLEND] LIQUORS

By T. C. Furnas

Test Liquor

An AAA liquor was prepared by dissolving 300 grams of ore in 195 ml 38° HNO₃, diluting to 600 ml, heating to 80°C, adding 21 conc. H₂SO₄, and filtering through a glass cloth. The cake was washed with 120 ml hot water, reslurried with 200 ml water, filtered and washed with 70 ml hot water. The filtrates were combined to make 705 ml AAA liquor containing both nitric and sulphuric acids in excess amounts.

Samples

The stainless steel samples tested in this experiment were secured as test blocks about one inch wide by three inches long by one-quarter inch thick. Each block had a single weld bead along one side extending the full length of the sample, and on the other side a weld bead extending the full length of the sample crossed by a short weld bead which extended the full width of the sample. The area of the sample was estimated at six and one-half square inches.

Method

Samples of stainless steels 304, 316, 317, and 347 were immersed completely or suspended so that they were about 60% immersed in this AAA liquor and placed on a steam bath under a reflux condenser so no water would be lost through evaporation. At appropriate intervals these samples were removed from the solution, rinsed, dried, and weighed to determine any weight changes. The temperature of the corrosive liquor during these tests was about 92°C.

Data

Date	Hours elapsed since previous weighing	Sample and Weight in Grams			
		304	316	317	347
6-6-45	0.0	85.1056	89.7500	88.9878	none
6-8-45	50.0	t85.0993 (0.0063)*	t89.7435 (0.0065)	t88.9827 (0.0051)	84.2700 ---
6-11-45	65.75	t85.0951 (0.0042)	t89.7383 (0.0052)	p88.9805 (0.0022)	t84.2632 (0.0068)
6-12-45	26.00	t85.0933 (0.0018)	p89.7372 (0.0011)	t88.9784 (0.0021)	t84.2612 (0.0020)

t = total immersion of sample during period prior to indicated weighing.

p = 60% immersion of sample during period prior to indicated weighing.

* amount in parenthesis is weight lost during test interval.

Calculations:

Sample area = $6.5 \text{ in}^2 = 41.9 \text{ cm}^2$

Sample density = 7.8 gm/cm^3

Weight of a stainless steel slab one centimeter thick having an area on one side of 41.9 cm^2 would be 327 grams.

Hence, one centimeter penetration per year on an area equal to that of the samples tested, i.e., 41.9 cm^2 would correspond to a loss in weight of 0.0373 gm/hour .

From this it is evident that the loss of one milligram per hour by any of the samples tested would correspond to a penetration of $0.0268 \text{ cm per year}$ or $0.01053 \text{ inches per year}$.

Table

Sample	Test	Hours	mg lost	mg/hour	Penetration inches/year
304	1	t - 50.0	6.3	0.126	0.00133
	2	t - 65.75	4.2	0.064	0.00068
	3	t - 26.0	1.8	0.069	0.00073
316	1	t - 50.0	6.5	0.130	0.00137
	2	t - 65.75	5.2	0.079	0.00083
	3	p - 26.0	1.1	0.071*	0.00074*
317	1	t - 50.0	5.1	0.102	0.00108
	2	p - 65.75	2.2	0.056*	0.00059*
	3	t - 26.0	2.1	0.081	0.00085
347	1	t - 65.75	6.8	0.103	0.00109
	2	t - 26.0	2.0	0.077	0.00081

t = total immersion of sample during test.

p = 60% immersion of sample during test.

* = these figures obtained by multiplying the actual loss by 5/3 to account for the fact the sample was only 60% immersed.

Conclusions

There is really very little actual difference between these four stainless steels in their resistance to the AAA liquor with which they were tested. Beyond their initial "pickling" losses, which were very low, they evened out at losses less than one-thousandth of an inch per year. This indeed would indicate a very satisfactory life for a tank made of any one of these stainless steels and exposed to this liquor.

From these tests it may be concluded that cost considerations only need govern the choice of stainless steel to be used in the fabrication of tanks to be used with liquors such as the one used for this test.

CORROSION OF STAINLESS STEELS
IN
AAA DIGESTION LIQUORS

SUBJECT: Corrosion Tests on Gasket Material
 TO: Mr. H. E. Thayer
 FROM: W. C. Rosenbaum
 DATE: November 27, 1945

Because the use of Hills-McCanna valves looked promising for use in a continuous extraction process, a number of sample diaphragms were obtained and Mr. Furnas tested these samples in ether, ether-acid "hex" solution, and in water-acid "hex" solution. As the result of these tests, Koroseal was proved to be the best all round material.

The following materials were tested.

Name	Hills McCanna Type
Thiokol	D2A
Neoprene	P233 (P141B)
Neoprene	N1A
Hycar	H68A
"Synthetic" rubber	S1A
Koroseal	

Additional data is appended hereto.

EIGHT DAY CORROSION TEST

6

Properties		Thiokol	Neoprene S1A	Neoprene P 233	Koroseal	Hycar	Synthetic Rubber
Color of solution		sl.	greenish yellow	greenish yellow	colorless	yellow-sl-green	very sl. color
Ether Only	Weight Change	+ 4%	+ 14.6%	+ 12.5%	ca. -8%	+ 4.2%	+ 28.2%
Room Temp.	Length Change	+ 2%	+ 7.3%	+ 6.25%	-----	+ 2.1%	+ 12.5%
	Remarks		Lots of stretch	very little stretch	laminations separated. Material OK	OK	Broke in tension
Color of soln.			deep orange	deep orange	lt. yellow no change	lt. orange	very sl. orange
Ether-acid	wt. change	blistered	-----	-----	+ 4.1%	-----	-----
"Hex" soln.	Length change	partial	+ 8.3%	+ 12.5%	-4.2%	+ 33%	+ 12.5%
Room Temp.	Remarks	Disintegrated	surface fell apart in removing from bottle	surface wipes off somewhat	strong and tough. Mat'l. now opaque instead of translucent	Tears easily (Torsion)	Tears easily (Torsion)
Water-acid		Completely	-----				
"Hex" soln.	Wt. Change	Disintegrated	-----	-----	+ 1.4%	-----	-----
74°C	Length change	-----	-----	-----	-----	-----	-----
	Remarks		Surface wipes off	Surface wipes off badly	opaque, strong, tough	cracked surface wipes off	hardened surface, crumbles some

NYO-5129

(- means no data taken.)