CORROSION INDUCED BY COIR FIBRE IN PACKAGING

by

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ABSTRACT

An interesting case of extensive dezincification of wickless, pressure type oil stove which could be directly traced to the use of defective filling material in packaging was investigated.

Introduction

Dezincification is a form of corrosion of zinc alloy, usually brass, in which zinc is lost selectively and a residue or a deposit of less active constituent, copper, is left *in situ.*

The stoves were made from 60 : 40 brass (actual composition 58·5 : 41·5) and were packed in cardboard boxes. Coir was used for cushioning (see Fig. 1). The stoves were in storage for one year only. The condition of the stoves after the storage is shown in Figs. 2 & 3. The corrosion product collected from brass was not sufficient for quantitative chemical analysis. However, qualitative analysis was done and it indicated that the corrosion product almost entirely consisted of zinc compounds, with only traces of copper. Metallographic examination was carried on a transverse cross section near one of the dezincified-areas using a Vickers Projection Metallurgical Microscope at $\times 100$ magnification. It was observed that the brass suffered typical dezincification of the "plug" type (confined to local areas unlike "uniform layer type" distributed over broad areas). That it was a case of dezincification was confirmed by the facts that the copper left as residue showed the typical red colour of the metal and that it was porous and could be easily removed from the "plug" by light scratching.

The dezincification was found to have proceeded in some regions to a depth of 0·01″ in a sheet of 0·03″ thick. In Fig. 4, the photomicrograph of the unetched transverse section at $\times 100$ Magnification is shown. The contact between the coir filling material and the stove was so intimate at places that coir fibres were found embedded in the corrosion product which followed the course of the fibre. The top plate (also packed with the stove), which was made of mild steel and coated with a bronze lacquer was also found to have rusted.

Water soluble extract from the coir gave the following analysis calculated on the dry weight of coir:—

Total chlorides as *Cl*	2·5%
Total sulphate as SO_3	0·3%
pH of 1% aq. extract	6·2

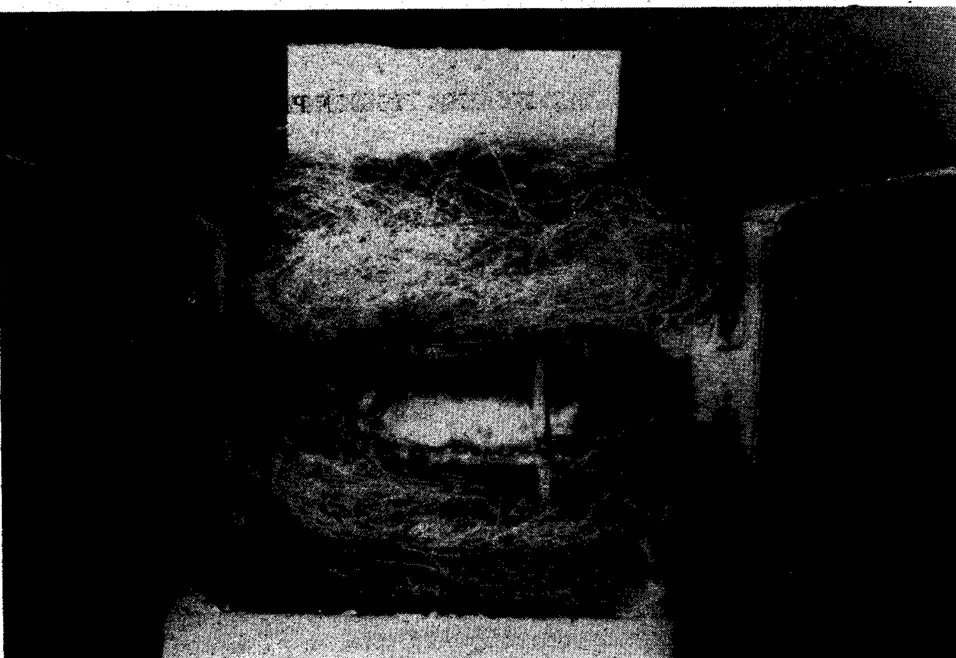

Fig. 1.—The method of packing.

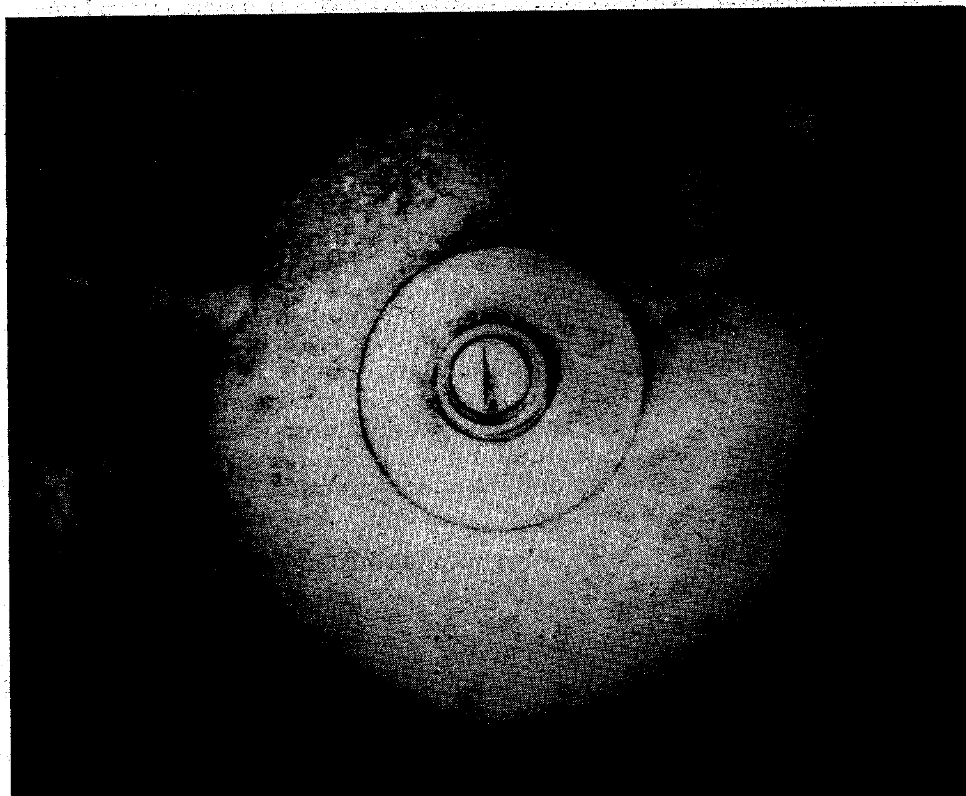

Fig. 2.—The condition of stove.

Fig 3.—The dezincification effect. Note the course of dezincification along the contact of the fibre with the surface.

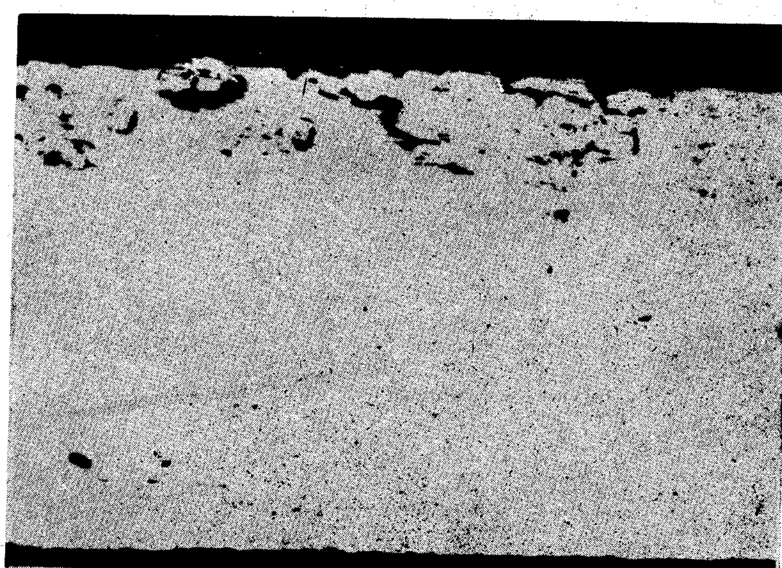

Fig 4.—The depth of penetration of dezincification in stove.

The high salt content of the coir, as shown by its water soluble chloride and sulphate content, was probably acquired during retting of the cocoanut fibre in sea water in the coir producing coastal areas of the country. It was obvious that this high salt content along with any condensed moisture inside the package was responsible for the corrosion of the stove. This was confirmed experimentally.

Experimental

The experiments were designed to study the rate of corrosion of brass in the presence of coir under three different conditions of exposure—

(*a*) metal immersed in 1% extract of coir,
(*b*) metal kept in proximity to coir,
(*c*) metal in close contact with coir.

The experiments were carried out using three different types of coir, (*i*) coir used in the packaging of the stove, (*ii*) coir same as in (*i*) but thoroughly washed with hot water (washed coir), (*iii*) "Raw" coir fibre removed from cocoanut pith. Samples (*ii*) and (*iii*) were found to be free from chlorides and sulphates.

Brass panels, 2″×1″ with a hole in the middle near the smaller side, were polished and degreased with carbon tetrachloride. The panels were hung inside with 1¼″ nichrome wire hook from the loosely fitting lid of a tall bottle 7½″ high and 3-3/8″ outside diameter (See Fig. 5). 50 ml of distilled water were kept in the

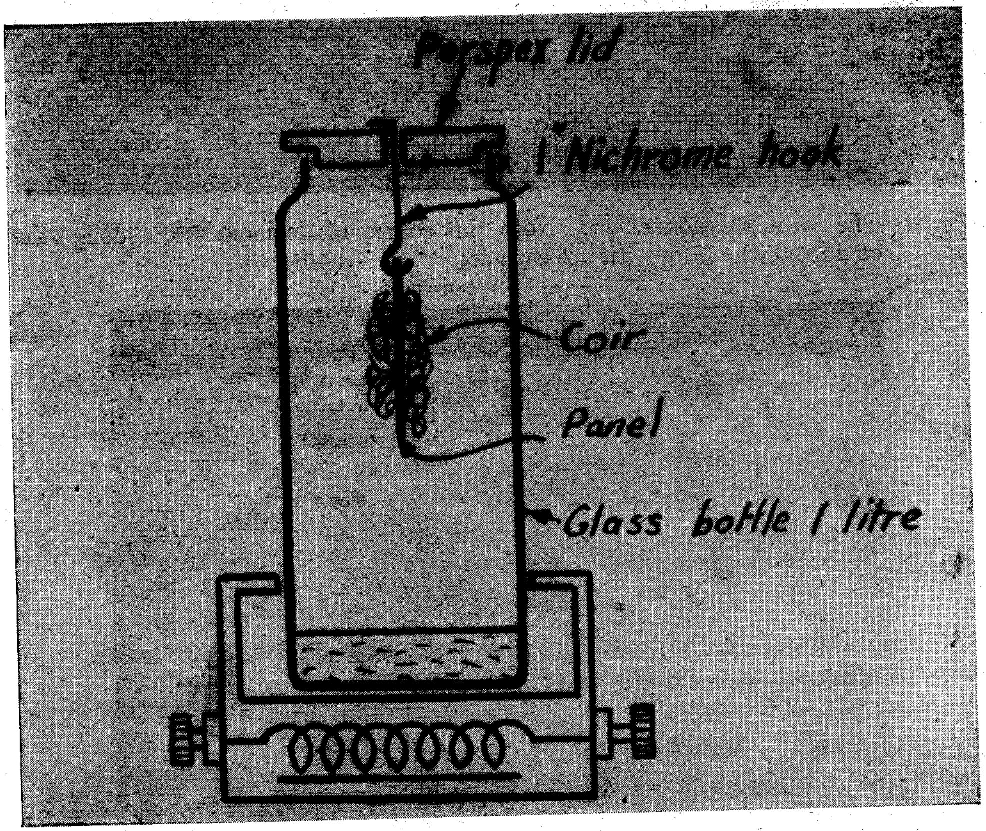

Fig. 5.—Experimental set up to simulate conditions inside the package leading to dezincification of brass panel by coir.

bottle. The water was heated such that the average temperature below the panel was about 40°C and that continuous condensation of water occurred over the panel. The average room temperature was 21°C. The total period of exposure was 12 days. The quantity of water lost through evaporation was made up by periodical additions. The loss of metal was determined at the end of the exposure period by treating the corroded brass panels with 5% sulphuric acid for 1 minute. The experimental results are shown in Table below. Figs. 6 & 7 show the condition of the brass panels under various experimental conditions.

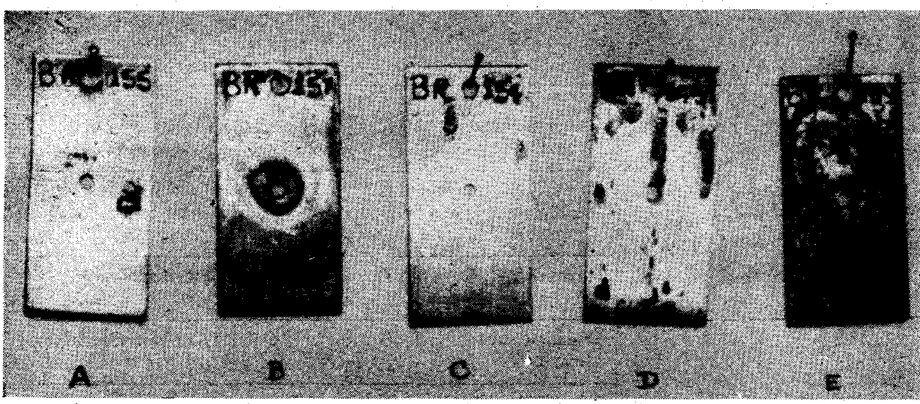

Fig. 6.—The condition of the brass panels in the presence of coir used for packaging of stove.
(A) Immersed in distilled water.
(B) Immersed in coir extract.
(C) Kept suspended above distilled water.
(D) Kept suspended above distilled water.
(E) Kept in close contact with coir over water.

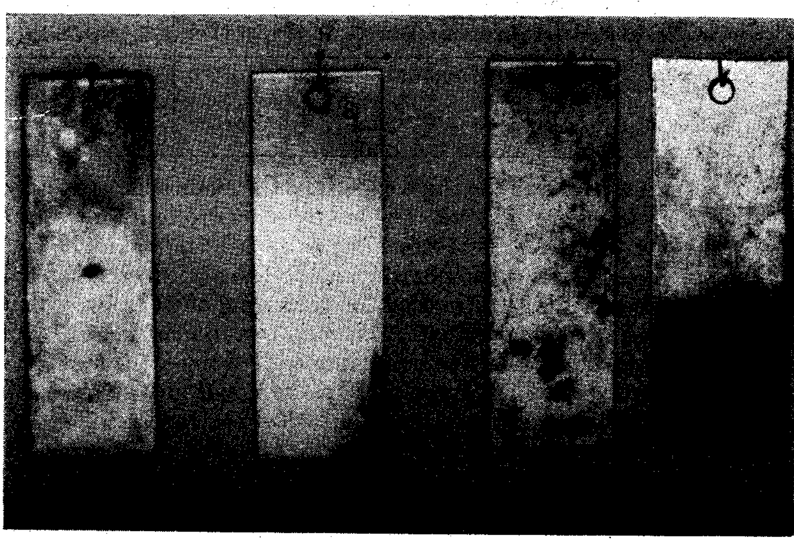

Fig. 7.—The condition of the brass panels in the presence of raw coir and washed coir.
(F) Immersed in raw coir extract.
(G) Kept suspended above distilled water and raw coir.
(H) Kept in close contact with raw coir over water.
(J) Kept in close contact with washed coir over water.

TABLE

Corrosion of Brass Panels in the Presence of Coir

Experimental Condition	Coir used	Mark on panel	Loss in weight—mg. per specimen (2″×1″)	Condition of the panel surface
Brass panels immersed in 1% water extract of coir.	Distilled water (control)	A	2·8	One discoloured spot observed
	Coir used in packaging	B	3·4	Discoloured with slimy adherent product
	Raw coir ..	F	1·4	One discoloured spot observed
Brass panels suspended over coir dipped in water.	Distilled water (control)	C	1·5	Discoloured patches
	1 gm of coir used in packaging	D	3·3	Number of copper coloured patches
	1 gm. of raw coir	G	0·6	One discoloured patch
Brass Panels kept in close contact with coir over water.	1 gm of coir used in packaging	E	9·5	White corrosion patch along line of contact
	1 gm of raw coir	H	1·8	Slight staining
	1 gm of washed coir	J	2·0	Slight staining

It will be seen that under all the three experimental conditions, the samples of coir used for the packaging of stove promoted more corrosion of brass than the chloride free coir samples. This effect is particularly marked where the coir was kept in direct contact with brass panel. The corrosion suffered by the brass panels in contact with coir used for packaging of stoves was similar to that observed on the stoves and the rate of corrosion was much higher (9·5 mg) than those obtained with chloride free coir samples (1·8 mg—2·0 mg). This experimental condition represents more closely the conditions of packaging of stoves and therefore, more importance is attached to these results.

Conclusion

Natural coir does not contain any chloride but when processing is carried out by retting in sea water as is the common commercial practice, coir is contaminated with chlorides from sea water and unless subsequently washed with sweet water to remove the chlorides they can promote corrosion of brass and other metals coming in contact with them.

It should, therefore, be ensured that when coir which is a cheap and very good cushioning material is used in packaging metallic equipment/stores, this should be free from chlorides and other corrosion promoting electrolytes.

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