	ISO 9001 Company	<b>Bharat Heavy Electricals Limited</b> (A Govt of India Undertaking) Tiruchirappalli 620014, India
<b>U.ANTHONISAMY</b> Dy. Manager Field Engg. Services	Off : 0431 - 2521415, 2575040 Res : 0431 - 2553688, 2573040 Fax : 0431- 2520752, E mail: uanthoni@bheltry.co.in	

FES/BASL/Lab. report/758  
19/11/2004.

The Executive President / AGM / ENGG.  
Bannari Amman Sugars Limited  
Post box. No.16  
Sathyamangalam - 638 401  
Erode Dt.



CCP - DW

Dear Sir,

Sub: Failure analysis of Super heater coil, SH External Deposit and Wood chips collected from 120TPH boiler of BASL - reg.  
Ref.: MOM dated 18.08.2004 at BASL.

The above samples collected from BASL were analyzed in our laboratory and a copy of the analysis report is enclosed for your reference. From the analysis report following observations can be made:

- The super heater tubes have failed due to metal wastage and thinning by corrosion. Pitting is found on the OD surface of the failed sample.
- This is confirmed by the swab analysis of the external surface of Super heater tubes, which revealed presence of Chloride and Sulphur. The analysis of Super heater external deposit sample also indicates presence of very high quantity of SO<sub>3</sub>.
- The microstructure analysis of the tubes does not indicate overheating.

The following remedial measures are recommended for avoiding such failures in future:

- The chemical composition and the characteristics of the composition of the fuel fired should be thoroughly analyzed for its corrosion characteristics before usage to avoid the tube failures due to corrosion.
- The originally recommended fuels only may be used to avoid such failures in future.
- Also check effectiveness of soot blowers. Pressure and temperature of the soot-blowing medium to ensure effective cleaning.

With warm regards,

Sincerely yours,

  
U. Anthonisamy



**BHEL: TRICHY-14  
PLANT LABORATORY**

INV144/04

DATE: 07.09.04

ISSUED TO	DGM: FES (Attn. Sri.U.Anthonisamy)
REF NO	FES: TS: C.LAB: 3340 dt. 27.08.04
PROJECT	M/s. Bannari Amman Sugars Ltd, Sathyamanagalam UNIT 1 120 TPH
COMPONENT	Primary Superheater coil - 1 No (Assembly 17) Platen final Super Heater Coil unfailed - 1 No (Assembly10)
MATERIAL SIZE AND SPECN	Dia 51 x 5.6 mm SA 213 T91
WORKING TEMP & PRESSURE	510° C 90.5kg/cm <sup>2</sup>
SYN.DATE SERVIE HOURS	26 <sup>th</sup> August 2002 16,000 Hours

**INVESTIGATION:**

**VISUAL EXAMINATION:**

**Tube No.1:** The tube has opened up with thin lips. Wall thinning and metal wastage are observed in the opened up region. Oxide scale seen on ID and OD surfaces (Photo1). Mild pitting is seen on the OD surface.

**Tube No.2:** Unfailed tube. Oxide scale seen on ID and OD surfaces (Photo2).



Photo1



Photo 2

INV 144/04

**DIMENSIONAL MEASUREMENT (mm):**

Location and tube No.	Outer Diameter		Wall Thickness			
	0-180°	90-270°	0°	90°	180°	270°
1.Failed lip	-	-		-		-
1.Ring section little away	47.80	49.29	4.81	5.75	5.25	5.50
2.Ring section (unfailed tube)	49.79	49.17	5.58	6.06	6.63	6.79

**CHEMICAL COMPOSITION (%):**Test Method ASTM E415

Tube No	C	Mn	Si	S	P	Cr	Mo	V	Nb
1	0.10	0.35	0.39	<010	0.020	8.45	0.93	0.21	0.09
2	0.08	0.41	0.26	<010	0.019	8.36	0.91	0.19	0.07

**HARDNESS MEASUREMENT (HV 10):** Test Method ASTM E92

Location	0°	90°	180°	270°
1.Failed lip	221/206	-	206/206	-
1.Ring section a little away	228/221	221/221	221/221	221/221
3.Ring section	228/221	221/221	221/221	221/206

**STEAM SIDE OXIDE SCALE THICKNESS MEASUREMENT: (mm)**

Tube No	Thickness
1	0.153
2	0.115

**SWAB ANALYSIS:**

The swab analysis of the OD surface was carried out and the presence of chloride and sulphur have been detected on the OD surface. (Refer CTL 488/04 report enclosed)

**MICRO EXAMINATION:** Test Method E407

**Tube No.1:** The tube was transverse sectioned at the failed region and micro examined. The failed lip shows no deformation/ decarburisation of the adjoining grains on the surface of the edge. No overheating is observed on the failed edge. Some shallow rounded pits are seen near the OD surface. The pit edges also show no decarburisation of the adjoining grains on the surface. The microstructure on the failed lip consists of tempered martensite (Photo3). Opposite to the failed lip (Photo 4) and on a ring a little away from the failed region (Photo5), similar type of microstructure is observed.

**Tube No.2:** The unfailed tube shows no overheating. A ring section shows a microstructure of tempered martensite (Photo 6).

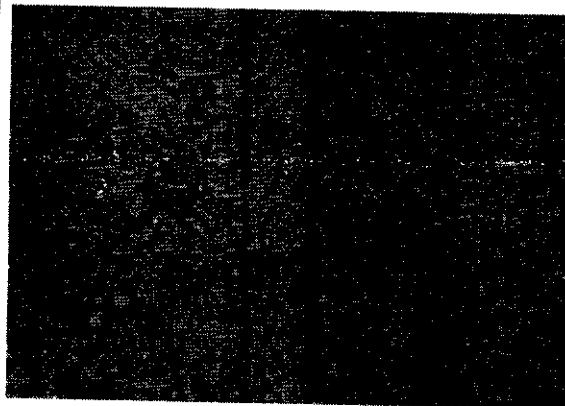


Photo 3      Mag 500X



Photo 4      Mag 500X

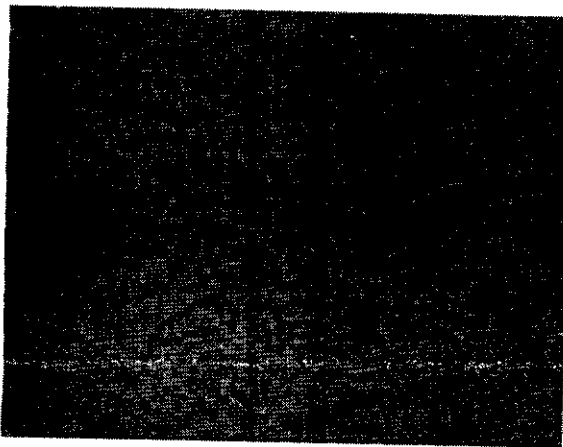


Photo 5      Mag 500X



Photo 6      Mag 500X

## REMARKS:

1	The chemical composition of the tubes meet the requirements of SA 213 T91
2	The mild oxide scale and the microstructure indicate no overheating on the superheater tube no.1 (Assy 17).
3	The presence of sulphur and chloride on the OD surface as noticed from the swab analysis and wall thinning indicate that the failure of the tube No.1 (Assy.17) is attributed to external metal wastage caused by corrosion on the OD surface of the tube.

*R. Vairam*  
SSO / PLANT LABORATORY  
Page 04 of 04

Note: 1.This is only a test report and not a test certificate.  
2.The results relate only to the items (sample(s)) received and tested at Plant Laboratory.  
3.This report shall not be reproduced except in full, without written approval of Plant Laboratory.

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## CHEMICAL SECTION / PLANT LABORATORY

Chemical Testing Laboratory (CTL) - Report

374-102/D

TEST REPORT No. CTL: 488/2004 DATE OF REPORT : 10/09/04  
 ISSUED TO SSO/METALLOGRAPHY SECTION  
 WITH REFERENCE TO HIS REQUISITION No INV 144/04 DT: 09.09.04  
 DATE OF RECEIPT OF SAMPLE 10/09/04  
 MATERIAL DESCRIPTION FAILED SH TUBE  
 SAMPLE STATUS AT RECEIPT GOOD

## THE FOLLOWING ARE THE RESULTS OF TEST CONDUCTED

SAMPLE RECEIVED FROM SSO/METALLOGRAPHY SECTION ON 10.09.2004.  
 TESTED AS PER APPROVED STANDARD METHODS  
 SWAB IS TAKEN FROM THE OUTSIDE SURFACE OF THE TUBE.

TEMPERATURE = 26 C % RH = 69

1. pH OF THE SWAB SOLUTION = 8.2
2. CHLORIDE CONTENT = PRESENT
3. SULPHUR CONTENT = PRESENT

REMARKS: QUALIFICATION NOT APPLICABLE.

AUTHORISED SIGNATORY / PLANT LABORATORY  
 L. GRAGORI,

Senior Scientific Officer,

NOTE: 01. THE REPORT RELATES ONLY TO THE SAMPLES TESTED.  
 02. THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITH THE  
 THE WRITTEN APPROVAL OF CHEMICAL SECTION OF THE PLANT LABORATORY.

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