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MADRAS RECORD OFFICE.

Government of Madras.

Public Works DEPARTMENT.

G.O. No. 1117 (24)	Press ~~Mis.~~
Dated 4-4-	1877.

Not to be folded or roughly handled

Proceedings of the Madras Government, Public Works Department,
4th April 1877. No 1,117.

No 39 Read the following endorsement of the Consulting Engineer for Railways,
dated Madras, 21st March 1877, No. 178 —

From Captain H W. CLARKE, R E, Officiating Deputy Consulting Engineer for
Railways in Sind, to the Consulting Engineer for Railways, Madras, dated
Kurrachee, 24th February 1877, No 143.

WITH reference to your letter No 180 of 3rd instant, I have the honor to
submit a precis of correspondence relating to the destructive effects of Babul wood
when burned in the fire-boxes of the locomotives of the Sind section of the Sind,
Punjab, and Delhi Railway.

2. The correspondence embraces a period from 1st April 1875 to the present
time, 1 year 10 months 22 days

*Precis of the correspondence regarding the destructive effects of burning wood in the fire-boxes of the
Engines of the Sind, Punjab, and Delhi Railway (Sind Section)*

In April 1875 it was discovered that goods engines Nos 1, 16 and 19 were greatly damaged
in regard to the copper crown-plate of the
Letter No 1,025 of 1st April 1875 fire-boxes It was believed that the damage
" " 1,039 of 3rd " " was due to the effects of the burning of Babul
" " 1,072 of 5th " " wood
From the Deputy Agent

Details in respect to these three engines are given in the following table —

Date	No of Engine	MILES RUN WITH		THICKNESS OF COPPER CROWN PLATE		Estimated cost of restoring fire boxes	Remarks
		Coal	Wood	Original	After run ning the miles men tioned		
7th April 1875 . . {	1	4,441	32,227	$\frac{3}{4}$ inch	$\frac{1}{16}$ inch	Rs 4,000	Found cracked by the driver, on the 7th September 1874 this plate was $\frac{3}{8}$ inch
	16	21,819	33,738	$\frac{1}{2}$ "	$\frac{1}{16}$ "	4,000	
	19	36,328	36,745	$\frac{1}{2}$ "	$\frac{1}{16}$ "	4,000	

The dimensions of the fire-boxes of Kitson's goods engines Nos 1, 16 and 19 are—

5 feet 0 inches in height

3 " 7 $\frac{1}{2}$ " in width

4 " 2 $\frac{1}{2}$ " in length

The fire-hole is oval, its top is 6 $\frac{1}{2}$ inches below the crown

The thickness of—

Crown plate is $\frac{3}{8}$ inch

Side plate is $\frac{3}{4}$ "

Tube plate is 1 " (at tubes)

Do is $\frac{1}{2}$ " (at water space)

Front $\frac{5}{8}$ "

Back $\frac{5}{8}$ "

2 The matter was referred to the Chemical Analyst at Bombay, who in his No 260 of
5th July 1875, states—

The copper of the fire-box has suffered from extensive oxidation, but to what special
primary cause this is due it is not at present easy to say with certainty

The metal itself contains no special corroding agent.

The wood yielded in distillation 432 per cent of acid, compared with European woods,
this is above the average

*Proceedings of the Madras Government, Public Works Department,
4th April 1877. No 1,117.*

To obtain pyroligneous acid, the wood is distilled by being heated in a retort while at the same time it is shut off from the air. In the locomotives the wood is burned in a free current of air, and the question then arises—

How does the vapour from the burning wood contain any pyroligneous acid at all?

In the retort, oxygen being excluded, no true combustion takes place, in the locomotive the combustion, in the current of air, is nearly complete.

Hence no pyroligneous acid can be formed. No trace of the acid could be detected on the corroded copper.

It is possible that the locomotives may be so constructed as to allow of the production of acid vapours in quantity sufficient to attack the oxide of copper. Copper when heated in air becomes oxidised no matter what fuel is burned. Pyroligneous acid coming into contact with the oxide thus produced would unite with it to form an acetate of copper, which would in its turn by the continued action of heat become again reduced to oxide, and in this way the oxidation of the copper would materially be hastened. To obtain a practical result, the investigation should embrace the following points—

- Are acid vapours from the burning wood present in the engines?
- To what height do the flames rise in the case of wood, and again in the case of coal?
- In each case, to what extent do the flames come in contact with the crown plate?
- Is the coat of soot thicker with the use of coal than with wood?
- Compare the position of the crown plate in the Sind engines with its position in the engines of other railways.
- Have the engines on other lines suffered from the use of Babul? If not, this wood probably contains no corroding agent. In any case it will be well to analyse Babul from different districts and to ascertain whether other kinds of wood ever produce destructive effects on copper. In reply it was stated—

No 1107 of 7th August 1875, from Deputy Consulting Engineer

3 There is an appearance of vapour from burning wood. The color of the surface of the copper of the fire-box is bluish white.

When using wood fuel the fire-boxes are filled to the fire hole doors, consequently the flame is in constant contact with the crown plates; in the case of coal, the depth of the layer of coal is 2 inches to 3 inches on the fire-bars, and the flame is in a measure prevented from striking the crown plates by a buffle plate, which projects from the fire hole to the inside of the fire boxes.

The side plates of the fire-boxes, as well as the crown plates, are deteriorated by the use of wood fuel.

A slight coating of soot is formed when coal is used, but not with wood fuel. The fire-boxes are similar to those on other railways in India.

4 The Civil Surgeon (Dr Keelan) of Kotree in Lower Sind, in his No 320 of 19th September 1875, states—

The oxygen of the current of the air in its passage through combines with the copper of fire-box to form a base, which has affinity for the acid of the wood, thus a substrate of copper or verdigris is formed, which becomes immediately charred and decomposed from the heat of the fire, producing scales which fall off slowly. Fresh surfaces are thus exposed, which are again acted on.

That pyroligneous acid does occur in the smoke is beyond question, considering that the Babul wood contains 432 per cent of this acid. Any one who differs ought to examine the plates so acted upon and then pronounce judgment.

If the Babul be dense enough, it takes some time to burn and pyroligneous acid is formed in the interior of each piece of wood, as in a retort, the acid forming in a latent state in the wood where no oxygen can penetrate.

If thin pieces be burned, combustion will immediately take place and no acid can be formed. The acid once formed is carried off with the watery vapour over the surface plates.

*Proceedings of the Madras Government, Public Works Department,
4th April 1877. No 1,117*

5 The Chemical Analyst at Bombay, in his No 137 of 13th March 1876, writes—

- Do engines on other railways burning wood in the same way suffer from corrosion?
- Is the corrosion inseparable from the combustion of the wood and independent of the variety of wood? Is it due to the particular variety of Babul used?
- If some engines burning wood do not suffer, or only in a slight degree, then it may be asked what wood do these engines burn, and is it burned under the same conditions as to freedom from draught and contact of flame with the plates?

6 With letter No 323 of 11th April 1876, the following information was supplied to the Analyst—

No 620, dated 4th June 1875, from the Secretary to Government of Bombay

Bombay, Baroda, and Central Indian Railway—Babul fuel has been used too short a time for any decision on the matter to be given.

No 1613, dated 18th June 1875, from Consulting Engineer

East Indian Railway—During the ten or twelve years that wood was used no evil effects were noticed. Coal only is now used.

No 1431, dated 19th June 1875, from Deputy Consulting Engineer

Oudh and Rohilkund Railway—Registered mileage of engine No 4 is 31,922. Probable time 55,000.

The crown and tube sheets are of uniform thickness, $\frac{1}{4}$ ths of an inch, they have not suffered from the effects of the fire, they are free from any appearance of scorching, the use of wood has not been detrimental to the fire-boxes or tubes, the tubes are in very good condition.

No 1,927 W, dated 2nd October 1875, from the Director of State Railways

Northern Punjab and Holkar Railways—The locomotives do not appear to have suffered deterioration from the use of wood fuel.

The engines used were—

- The "Gnat" 5 feet 6 inches gauge tank engine, 4 wheels coupled, worked for two years on the Northern Punjab.
- Six metre gauge engines, classes A and B, delivered to the Northern Punjab between June 1872 and February 1875. All these have copper fire-boxes and brass tubes.

The fire-boxes and tubes of the metre gauge engines show no signs of deterioration. Although one has been in constant work for two and a half years, the fuel used has almost exclusively been Babul cut very small (maximum length 1 $\frac{1}{2}$ th feet) and well dried. The sound condition of the engines is due to the kind and size of the wood-fuel and to its being used in a dry state.

No 3,216 of 13th November 1875, from Secretary to the Government of Madras

Madras and South Indian Railways—In respect to the Madras Railway

Fire wood is a most satisfactory description of fuel for burning in locomotives, not only in an economical point of view as regards the price, but also in causing less injury to the fire-boxes and tubes.

From the records of the last fourteen years, it appears that the copper fire-boxes of engines which have been burning wood have worn for a longer time than those of engines using coal.

The copper-boxes appear to be much more affected by the gases from coal than by those from wood. When wood is used fire-bars are not liable to be burned by the accumulation of clunkers, tubes last about the same time whether coal or wood fuel be used.

	RAILWAYS	
	Sind, Punjab and Delhi	Madras
A ton of wood measures	C FFET 90 to 100	C FFET 67.2
Do coal would in wood be equivalent	155.7 to 220	201

Proceedings of the Madras Government, Public Works Department,
4th April 1877. No 1,117.

Many kinds of wood are used as fuel, the admixture of Babul is but small
The following table gives details in respect to engines burning wood and coal —

MADRAS RAILWAY ENGINE			New Fire box and Tubes for the first time	WILL REQUIRE			Fire-box was re- newed after years	Remarks
No	Years running	Mileage		Fire box	Boiler	Tubes.		
<i>Wood Burning</i>								
38	13	303,280	Yes		.	.		
41	13	289,308	Yes			.		
45	13½	249,482	Yes	..	..	..		
51	13½	261,703	Yes					
<i>Coal Burning</i>								
57	13½	105,327	.	Yes*	Yes*	Yes*	8½	
58	13½	221,572	.	Yes*	Yes*	.	8½	* In two years
62	12½	181,059	..	†	†	Yes†	7½	
65	12½	197,767		Yes†	Yes†	Yes†	8½	† Shortly

In respect to the South Indian Railway, our engine tubes and fire-boxes run better with wood-fuel than with coal. An engine which had run 20,000 miles was, after examination, pronounced to be fit for 60,000 miles more.

For instance—

Six wheel coupled goods engine No 17 is seven years old, a new set of tubes was put in her with which she ran 22 months, the tubes were then drawn (on account of repairs to the tube-plate) and replaced with new ends brazed on. The engine then began to burn wood, she has run (with wood) 20,000 miles. The fire-box is in good condition with uniform thickness of 1½ths of an inch original thickness 1½ths of an inch on top and sides of fire-box,* the piece of tubes are in good order weighing 19 lbs, the weight of a new tube is 23½ lbs.

These tubes are good for 60,000 miles more. Of the wood-fuel 15 per cent. is Babul, the rest junglewood.

No 4910, dated 1st June 1875, from the Secretary to the Company.

No 587, dated 28th May 1876, from the Consulting Engineer, Lahore.

Great Indian Peninsula Railway—Wood is not burned in any of the locomotives.

Sind, Punjab and Delhi Railway—No ill effects have been observed from the use of "Jhund."

Jhund entirely free from other kinds of wood has not been burned. The woods used are—

- | | |
|-------------|----------|
| 1. Jhund† | 4. Paloo |
| 2. Babul | 5. Dhak. |
| 3. Pharash. | |

The first three are mixed; the fourth is abandoned because its bark formed a coating over the ends of the tubes which interfered with the steaming of the engines and created a small offensive to the passengers. Babul is the best wood-fuel.

7. The Chemical Analyst at Bombay, in his No 238 of 8th May 1876, asked for samples of the wood-fuel used on the railways in India.

8. The request that samples of saw dust might be furnished having been made on 14th May 1876, the result was as follows —

No 1216 of 31st May 1876, from Consulting Engineer

East India and London Bengal Railways—(Coal only is used on these railways)

* This is not clear

† The Conservator of Forests, Punjab, in his No 82 of 24th May 1875 says "Jhund is easily raised from seed it suffers less from frost than Babul, it is very hard, it grows in drier ground than Babul. It is as good as wood, its growth from seed is slow, when coppiced, it produces a growth; Eight ounces of each kind of wood."

Proceedings of the Madras Government, Public Works Department,
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Bombay, Baroda and Central India Railway—A sample packet of Babul saw dust is sent, Babul is the only wood-fuel used, it has not been found to act injuriously. On the other railways no wood-fuel is used.

No 122 of 1st June 1876, from Consulting Engineer

Sind, Punjab and Delhi Railway (Punjab Section)—Saw dust of the following woods is sent —

Punjab Section				Northern Punjab			
			Prop used				Prop used
Jhund ...	.	.	33 33	Jhund . . .	..	..	50 0
Babul . . .	.	..	33 33	Bair . . .	.	.	20 0
Paloo ...	.	.	33 33	Babul ..	.	..	30 0
			100 00				100 0

Furash

Kurreel

Madras and South Indian Railways—Bags containing the saw dust of the woods used on the South Indian and a packet of saw dust of woods used on the Madras Railway are sent.

No 84 of 27th June 1876, from Consulting Engineer

Oudh and Rohilkund Railway—A tin-lined case containing three samples of saw dust is sent, one pound of each kind of wood-fuel is packed and labelled, the woods used are—

Constantly				Seldom.			
Mangoe . . .	..	..	80 00	Kutha			
Sal . . .	.	..	12 00	Gooler			
Babul ..	.	..	0 06	Sisum (jungle)			
Mowha . . .	..	..	2 20	Sisum (forest).			
Tamarind ...	..	..	0 24	Nim.			
Dak . . .	..	..	1 54	Jamun.			
Jungle ..	..	..	4 00				
			100 00				

9. With this office No 709 of 21st August 1876, samples of saw dust of the wood-fuel used by—

- Bombay, Baroda and Central India Railways
- Sind, Punjab and Delhi Railway (Punjab section).
- " " (Sind section)
- " " "
- Punjab Northern
- Madras and South Indian Railways

and 5 Madras and South Indian Railways

6 Oudh and Rohilkund Railway were sent to the Analyst at Bombay.

10 The Chemical Analyst, in his No 538 of 9th October 1876, states—

Nine of the samples of saw dust were submitted to destructive distillation, with the following results —

Babul—				Acid per cent			
1	Sind, Punjab and Delhi Railway (Sind Section)	.	.	.	.	.	3 78
2	" " " (Punjab Section)	..	..	..	..	..	4 74
3	Punjab Northern ...	..	..	..	..	..	3 96
mixed saw dust in the proportion usually burned on the—							
4.	South Indian Railway	..	..	..	..	..	2 83
5.	Sind, Punjab and Delhi Railway (Punjab Section) *	..	..	..	..	..	3 18
6	Northern Punjab †	..	..	..	..	..	3 00

* A mixture of Nos 7, 8 and 2 in equal proportion.

† A mixture of Nos 9, 10 and 3 in the proportion of—

5 parts No 9

2 " " 10,

3 " " 3.

*Proceedings of the Madras Government, Public Works Department,
4th April 1877. No 1,117.*

These per-centages of acidity are lower than 3.78 the percentage of acidity of Babul, which only is used on the Sind, Punjab and Delhi Railway (Sind Section)
Sind, Punjab and Delhi Railway (Punjab Section)

7. Jhund	..	...	..	..	..	..	..	1.80
8. Peeloo	..	..	..	..	..	..	..	3.00
Punjab Northern Railway								
9. Jhund	..	..	..	..	..	..	..	2.16
10. Bair	..	..	..	..	..	..	..	3.60
Oudh and Rohilkund Railway.								

11. Mangoe 5.82

In respect to the Oudh and Rohilkund Railway the Chemical Analyst inquired—

- Was wood-fuel only used with engine No. 4 during the whole or part of its service?
- Was mangoe the wood chiefly used?
- Were the crown and tube sheets unrenewed during the service of the engine?
- Are the conditions under which the wood was burned in engine No. 4 identical with those under which wood was burned in the engines of the Sind Section of the Sind, Punjab and Delhi Railway in regard to contact of fire with crown plate and supply of air?

No 2,515 of 21st Nov 1876, from Consulting Engineer following replies were given with this office No 1,008 of 4th December 1876 —

- Coal was at times in small quantities used
- Mangoe was the wood chiefly used
- None of the original plates of the engine have been renewed.
- The conditions are believed to be the same

From the Chemical Analyst to Government, to the Deputy Consulting Engineer for Railways in Sind, dated 6th March 1877, No 129.

I HAVE the honor to acknowledge receipt of your letter No. 136 of the 21st ultimo

2. The information in regard to the Oudh and Rohilkund Railway engine, forwarded with your endorsement No. 1,008 of the 4th December last, appears to me to completely negative the theory that the corrosion noticed in the Sind Railway engines resulted from acid vapours formed during the combustion of the wood used as fuel

3. If you refer to my letter No 538 of the 9th October, you will see that the per-centage of acid yielded on destructive distillation by mangoe wood, the fuel employed on the Oudh and Rohilkund Railway, is considerably larger than the per-centage of acid yielded by the Babul wood employed on the Sind Railway. At the same time the report of the Locomotive Superintendent of the Oudh and Rohilkund Railway covered by your endorsement No. 1,008 shows that no corrosion similar to that found in the Sind Railway engines has been noticed to occur in an engine of the Oudh and Rohilkund Railway in which mangoe wood was the principal fuel employed. The conditions, moreover, under which the wood was burnt in the Oudh and Rohilkund Railway engine are stated to be "essentially the same" as the conditions under which wood was burnt in the corroded engines of the Sind Railway. In face of these statements I do not see how it can be maintained that acid vapour from the wood fuel was the cause of the corrosion in the Sind engines.

*Proceedings of the Madras Government, Public Works Department,
4th April 1877. No. 1,117.*

No 183.

Copy forwarded to Colonel Shaw Stewart, Consulting Engineer for Railways, Madras, in continuation of this office No 143 of 24th February 1877.

(Signed) H. W. CLARKE, Captain, R E,
Offg Dupty Cong Eng. for Railways in Sind.

SUBMITTED for the information of Government.

2. The precis of the correspondence relates to the supposed destructive effects of Babul wood when burned in the fire-boxes of the locomotives of the Sind Section of the Sind, Punjab and Delhi Railway.

(Signed) J. H. M. SHAW-STEWART, Lt-Col, R E,
Consulting Engineer for Railways.

No. 40. ORDER THEREON, 4th April 1877, No 1,117.

RAILWAY, No 12.

ORDERED to be recorded.

(True Extract)

(Signed) J. H. M. SHAW-STEWART, Lieut-Colonel, R E,
Joint Secy. to Govt, P.W.D.,
Railway Branch.

To the Consulting Engineer for Railways.

Exd E O Shunker
Spare Copies

N^o 143 of 1877

Office of Dy. Consulting
for Railways in Sind

Murree 24th February 1877

From, The Deputy Consulting Engineer
for Railways in Sind

To, The Consulting Engineer
for Railways
Madras

Sir,

With reference to your letter
N^o 100 of 3rd instant, I have the honor to submit
a precis of correspondence relating to the
destructive effects of babul wood when burned
in the fire-boxes of the Locomotives of the
Sind Section of the Sind Punjab and
Delhi Railway.

2. The correspondence embraces
a period.

from 1st April 1875 } = 4th 10th day
to the present time } = 4-10-22

I have the honor to be
Sir,

Your Most obedient Servant

H. H. Clarke

Captain
R.E.
offg. Dy. Consulting Engineer for M. and C.

P.W.D

SE 1877

No 3128

1-1

Acknowledged in No 4178 15-3-77

5. March

PUBLIC WORKS DEPARTMENT,
Railway Branch.

Consulting Engineer's Office,
Madras, 21st March 1877.

6B

Letter No 143 of 24th Feb. 1877 with
enclosure from the Dy. Commg. Engineer for
Railways in Ind.

Also endorsement No 188 of the
12th March 1877 from the same
Officer No 178.

SUBMITTED for the information of Government

The précis of the correspondence
relates to the destructive effects of
kabal wood when burned in the
fire boxes of the locomotives of the
Sind section of the Sind Punjab
and Delhi Railway

(A sample of wood
with sufficient water - sufficient
to prevent burning - actually has
but a little depth on the
top - or a very small depth
on the side)

M. M. M. M.
D. C. C. C.
Cons. Engr for Rys.

4041 April 11/77 No 39

P.W.D.

25th 1877

1877

from
to ~~the~~ ~~Eng~~ for Railways

Dated 21st March 1877

Order. 178

Govt. of 1877

PUBLIC WORKS.

To The Cong: Engrs for Rys.

Dated

Issued

Recd

1877

G O 4th April 1877, No 1117

U. Nos. 39-40

Ind Punjab and Delhi
Railway - Correspondence
relating to the supposed
destructive effects of babul
wood when burned in the
fire-boxes of the locomotives
of the Ind section of the
—, recorded.

by 10th April 1877

C. E. Rys ✓
Dated 27-4-77

No 1117 of 4 April 77

Ordered to be

Recorded

U.