Installation of Condensate Recovery System - A Case Study Of Jindal Steel Ltd

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Abstract:- Condensate is a valuable resource and even the recovery of small quantities is often economically justifiable. The discharge from a single steam trap is often worth recovering. Un-recovered condensate must be replaced in the boiler house by cold make-up water with additional costs of water treatment and fuel to heat the water from a lower temperature. Condensate is such a valuable resource that the recovery of even relatively small quantities is economically justifiable. Even the discharge from a single steam trap is often worth recovering. Installation of condensate recovery system we can achieve maximum profit and savings. We can also save the electricity hence energy. We also reduce fuel and water charges by installation of condensate recovery system. Thus concluding this paper is seen that savings can be achieved by installing the condensate recovery system.

Keyword: *Condensate, recovery system.*

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Introduction:-

JSW STEEL COMPANY LIMITED

JSW Steel ltd. is a piece of O.P. Jindal Group. It's a 4 billion USD undertaking and India's fourth biggest business house. JSW was set up in 1970 and its first part was set up in Vasind in 1982. JSW is an incorporated element enveloping Steel, Power, Industrial gasses, Minerals and Port.
Condensate is an important asset and even the recuperation of little amounts is frequently financially legitimate. The release from a solitary steam trap is regularly worth recouping. Un-recouped condensate must be supplanted in the evaporator house by chilly make-up water with extra expenses of water treatment and fuel to warm the water from a lower temperature.

PROBLEM DEFINITION

The pickling process encounters many problems. The problems arising in this process is as follows

1. In the process plant, Steam cannot give all its heat in the course of its prime duty.

2. Valuable heat is therefore discharged as pressurized hot condensate.

3. This hot condensate is exposed to lowering of pressure certain quantity of condensate gets re-evaporated to steam. This low pressure steam is called Condensate steam.

These are the problems encountered by pickling process. Thus our aim of the project is to install new system to overcome these above problems.

Large savings can be achieved by recovery of condensate steam. We suggest the installation of **"Condensate Recovery System"**before pressure powered pump and the steam generated can be used for heating the process water or boiler feed water.

METHODOLOGY

Condensate Recovery

It is seen in the plant that the high vitality condensate which is recuperated from reactors, refining segments and different types of gear is sent back to cooling towers. This is a result of the suspicion of sullying. In the event that we convey this condensate to evaporator sustain water tank we can spare parcel of fuel and great measure of treated water.

Other Savings

1. Cost of treating the water (condensate is extremely pure, typically 2-10 ppmTDS).
2. Cost of the water itself.

How does CCDS solve the problem?

The Condensate Contamination Detection System [CCDS] can secure your kettle, guarantees item quality and spares vitality and water costs. The idea is to screen the condensate for the nearness of pollutions, and to continue returning it the length of it is perfect. The minute any ascent in sullying is distinguished, the condensate return line is consequently shut, and the debased condensate is dumped to pit. The parameter utilized by the CCDS to gauge defilement for your situation is Conductivity as we have to keep a beware of the TDS level to guarantee that just immaculate condensate does a reversal to the kettle.

What's in the System?

The system consists of a Sensor Chamber with a temperature compensated conductivity sensor which is connected to a low range controller that continuously monitors and displays the conductivity level. This controller gives signal to a 3 port flow diverging valve whenever overriding parameter is received from Conductivity controller.

These Sensors will be mounted in a by-pass line to the condensate return line. In normal operation, the dump port (pneumatically actuated) is closed and the return port of the 3 way valve is open, passing condensate back to the boiler house. If the conductivity of the condensate exceeds the set value, the controller will immediately shut the return valve and actuate the dump valve to drain the contaminated condensate. Please find enclosed the Quotation for the above system.

Installation of a CCDS

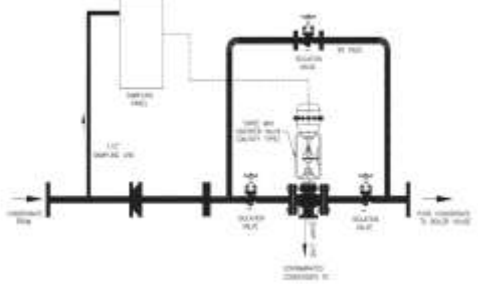

Fig.1 Condensate Contamination Detection System

EXPERIMENTAL WORK

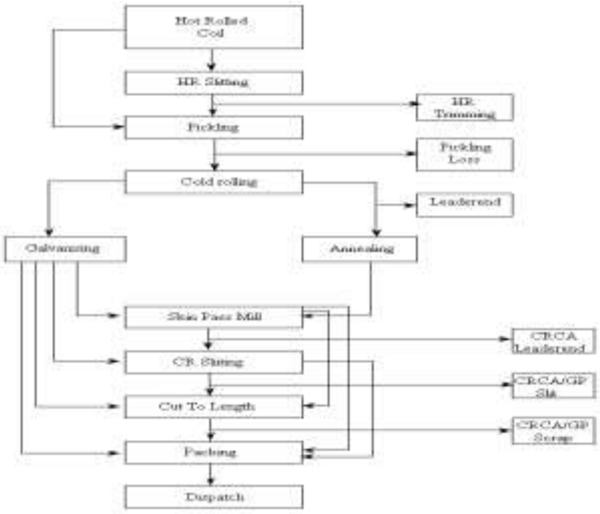

Fig.2Plant Layout

Readings and Graphs

It consists of condensate pump stroke time readings and its graphs.

Reading 1

Date :- 09/01/2012

Feed water level :- 90 cm

Time :- 11.30 AM – 12.30 PM

Boiler running :- 5 Ton

Feed water temperature : - 48 ^{0}C

Table.1 Reading 1

STROKE NO.	STROKE TIME (Sec.)	STROKE NO.	STROKE TIME (Sec.)
1	82	18	97
2	96	19	93
3	95	20	107
4	99	21	103
5	108	22	93
6	102	23	103
7	101	24	90
8	97	25	162
9	95	26	122
10	108	27	112
11	104	28	118
12	101	29	125
13	92	30	109
14	92	31	127
15	102	32	129
16	107	33	116
17	94		

Total Stroke Time = 3851 Sec.

Avg. Stroke Time =3851 / 33 = 117

During each stroke 30 lit. Water is used.

33 x 30 = 990 lit. / hr x 24 = 23760lit. / day

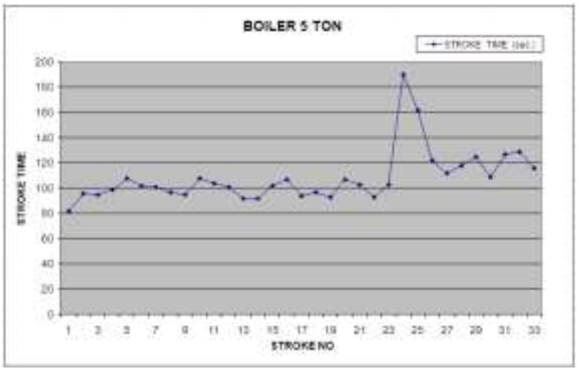

Chart 1 Stroke time v/s stroke no.

Reading 2

Date :- 14/01/2012

Feed water level :- 90 cm

Time :- 10.15 AM – 11.15 AM

Boiler running :- 3 Ton

Feed water temperature:-53 ^{0}C

Table 2 Reading 2

STROKE NO.	STROKE TIME (sec.)	STROKE NO.	STROKE TIME (sec.)
1	104	17	111
2	98	18	109
3	109	19	114
4	105	20	116
5	127	21	106
6	91	22	123
7	102	23	115
8	106	24	121
9	111	25	103

10	126	26	113
11	113	27	114
12	106	28	104
13	117	29	113
14	127	30	110
15	130	31	111
16	106		

Total Stroke Time = 3461 Sec.

Avg. Stroke Time = 3461 / 31 = 112

During each stroke 30 lit. Water is used.
31 x 30 = 930 lit. / hr.x 24= 22320 lit. / day

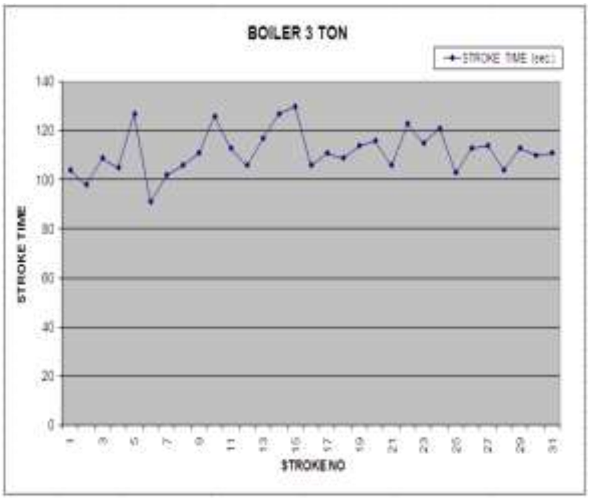

Chart.2 Stroke time v/s stroke no.

Reading 3
Date :- 14/01/2012
Feed water level :- 52 cm
Time :- 01.45 PM – 02.45 PM
Boiler running :- 3 Ton

Feed water temperature:- 67 ^{0}C

Table.3 Reading 3

STROKE NO.	STROKE TIME (sec.)	STROKE NO.	STROKE TIME (sec.)
1	120	13	145
2	210	14	135
3	119	15	134
4	129	16	136
5	271	17	140
6	253	18	167
7	183	19	141
8	184	20	140
9	161	21	144
10	155	22	129
11	161	23	137
12	162		

Total Stroke Time =3626 Sec.

Avg. Stroke Time =3626 / 23 = 158

During each stroke 30 lit. Water is used.

23 x 30 = 690 lit. / hr. x 24 = 16560lit. / day

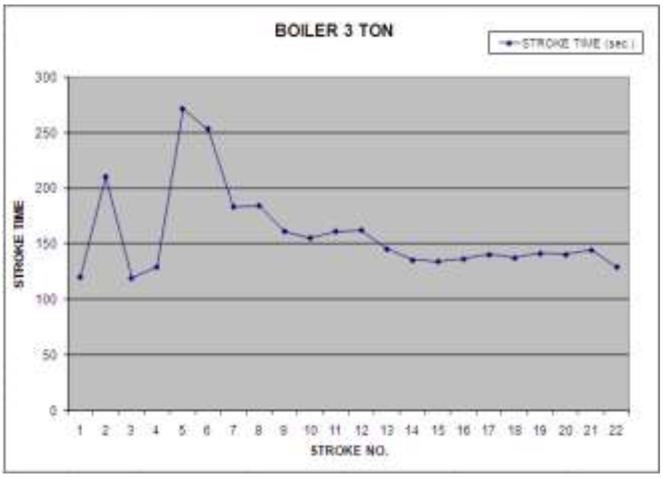

Chart 3 Stroke time v/s stroke no.

Reading 4
Date :- 16/01/2012
Feed water level :- 64 cm
Time :- 10.00 AM – 11.00 AM
Boiler running :- 5 Ton
Feed water temperature:-60 ^{0}C

Table 4 Reading 4

STROKE NO.	STROKE TIME (sec.)	STROKE NO.	STROKE TIME (sec.)
1	80	20	101
2	83	21	90
3	147	22	93
4	156	23	66
5	135	24	82
6	185	25	59
7	166	26	80
8	83	27	77
9	67	28	72
10	67	29	65
11	54	30	44
12	61	31	58
13	79	32	243
14	65	33	103
15	72	34	80
16	73	35	296
17	77	36	81
18	86	37	43
19	61		

Total Stroke Time=3530 Sec.

Avg. Stroke Time= 3530 / 37 = 95

During each stroke 30 lit. Water is used.

37 x 30 = 1110 lit. / hr. x 24 = 26640 lit. / day

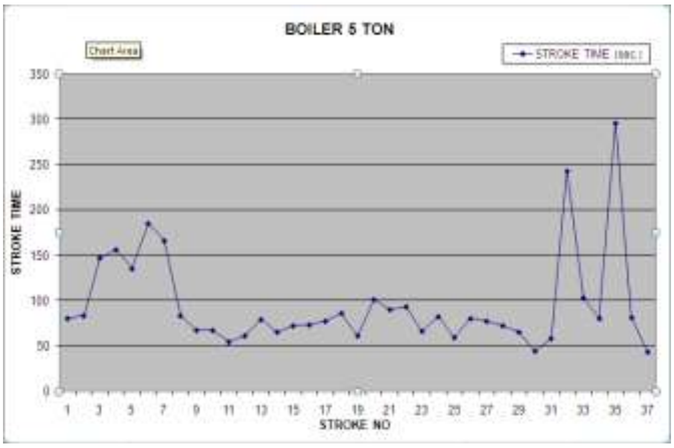

Chart.4 Stroke time v/s stroke no.

Reading 5
Date:- 16/01/2012
Feed water level :- 48 cm

Time:- 11.30 AM – 12.30 PM
Boiler running:- 3 Ton

Feed water temperature :- 69 ^{0}C

Table.5 Reading 5

STROKE NO.	STROKE TIME (Sec.)	STROKE NO.	STROKE TIME (Sec.)
1	58	16	84
2	57	17	87
3	412	18	117
4	52	19	93
5	63	20	89
6	93	21	85
7	60	22	85
8	48	23	91
9	96	24	93
10	98	25	137
11	96	26	231
12	98	27	101
13	86	28	174
14	85	29	91
15	85		

Total Stroke Time= 3621 Sec.

Avg. Stroke Time= 3621 / 29 = 125

During each stroke 30 lit. Water is used.

29 x 30 = 870 lit. / hr. x 24 = 20880lit. / day

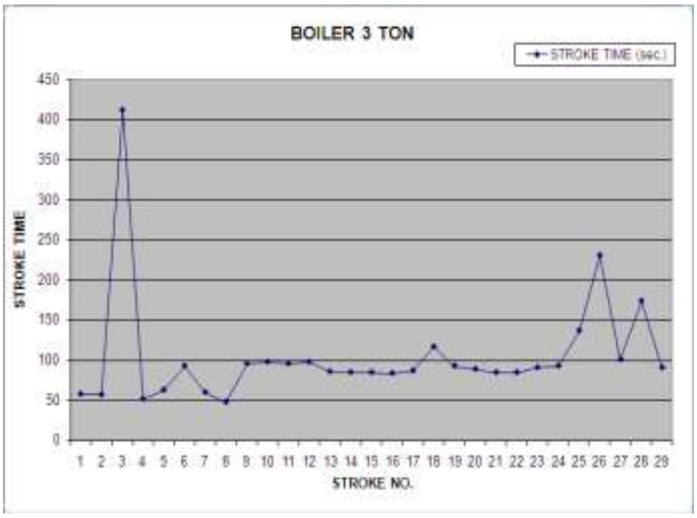

Chart.5 Stroke time v/s stroke no.

Reading 6
Date :- 16/01/2012
Feed water level :- 62 cm

Time :- 01.45 PM – 02.45 PM
Boiler running :- 3 Ton

Feed water temperature :-58^{0}C

Table 6 Reading 6

STROKE NO.	STROKE TIME (sec.)	STROKE NO.	STROKE TIME (sec.)
1	66	16	160
2	234	17	139
3	154	18	64
4	53	19	116
5	155	20	56
6	54	21	70
7	78	22	229
8	110	23	95
9	47	24	75
10	144	25	79
11	65	26	78
12	214	27	95
13	233	28	85
14	166	29	84
15	166		

Total Stroke Time =3364 Sec.

Avg. Stroke Time = 3364 / 29 = 116

During each stroke 30 lit. Water is used.

29 x 30 = 870 lit. / hr.x 24 = 20880 lit. / day

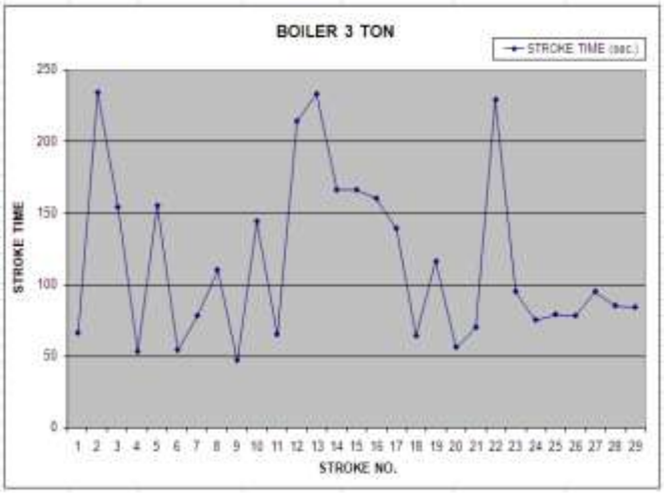

Chart.6 Stroke time v/s stroke no.

Chart.7 Stroke time v/s stroke no.

Reading 7
Date :- 18/02/2012
Feed water level :- 72 cm

Time :- 10.00 AM – 11.00 AM
Boiler running:- 5 Ton
Feed water temperature :- 78 ^{0}C

Table 7 Reading 7

Stroke No.	Stroke Time (Sec.)	Stroke No.	Stroke Time (Sec.)
1	68	21	103
2	65	22	92
3	63	23	83
4	72	24	57
5	75	25	50
6	90	26	76
7	142	27	62
8	159	28	55
9	96	29	57
10	93	30	62
11	103	31	64
12	254	32	65
13	91	33	63
14	86	34	68
15	49	35	69
16	48	36	69
17	60	37	69
18	99	38	68
19	103	39	69
20	100	40	70

Total Stroke Time = 3184 Sec.

Avg. Stroke Time = 3184 / 40 = 80

During each stroke 30 lit. Water is used.
40 x 30 = 1200 lit. / hr.x 24 = 28800 lit. / day

Reading 8
Date:- 18/02/2012
Feed water level :- 70 cm

Time :- 11.00 AM – 12.00 PM
Boiler running :- 5 Ton

Feed water temperature:-77 ^{0}C

Table 8 Reading 8

STROKE NO.	STROKE TIME (sec.)	STROKE NO.	STROKE TIME (sec.)
1	75	19	66
2	71	20	63
3	72	21	60
4	72	22	63
5	68	23	67
6	72	24	98
7	75	25	120
8	68	26	118
9	65	27	93
10	64	28	118
11	66	29	338
12	67	30	135
13	63	31	102
14	68	32	118
15	63	33	123
16	64	34	150
17	75	35	170
18	71	36	139

Total Stroke Time = 3380 Sec.

Avg. Stroke Time =3380 / 36 = 94

During each stroke 30 lit. Water is used.

36 x 30 = 1080lit. / hr.x 24 = 25290 lit. / day

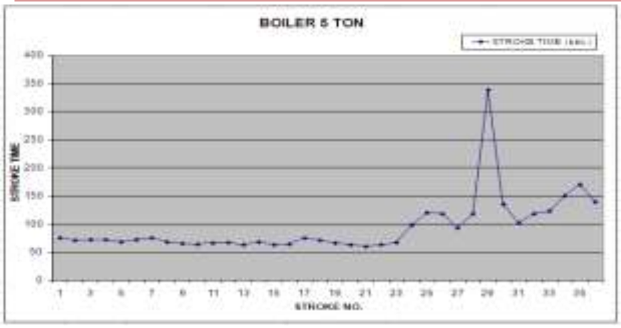

Chart.8 Stroke time v/s stroke no.

Reading 9
Date :- 18/02/2012
Feed water level :- 90 cm

Time :- 02.15PM – 03.15PM
Boiler running :- 5 Ton

Feed water temperature:-64^{0}C

Table 9 Reading 9

STROKE NO.	STROKE TIME (sec.)	STROKE NO.	STROKE TIME (sec.)
1	211	22	80
2	210	23	84
3	143	24	89
4	59	25	84
5	50	26	85
6	46	27	83
7	46	28	81
8	46	29	80
9	54	30	82
10	50	31	92
11	69	32	83
12	59	33	85
13	59	34	86
14	62	35	83
15	69	36	84
16	73	37	87
17	76	38	87
18	87	39	89
19	75	40	89
20	80	41	90
21	84		

Total Stroke Time =3311 Sec.

Avg. Stroke Time = 3311 / 41 = 81

During each stroke 30 lit. Water is used.

41 x 30 = 1230 lit. / hr.x 24 = 29520 lit. / day

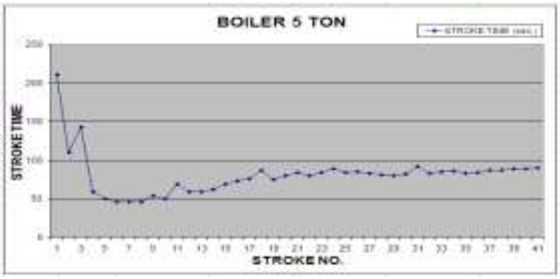

Chart 9 Stroke time v/s stroke no.

Reading 10
Date :- 03/03/2012
Feed water level :- 70 cm
Table.10 Reading 10

Time :- 10.45 AM – 11.45 AM
Boiler running :- 3 Ton

Feed water temperature :-76^{0}C

Total Stroke Time= 3583 Sec.

Avg. Stroke Time = 3583 / 50 =72

During each stroke 30 lit. Water is used.

50 x 30 = 1500 lit./hr.x 24 = 36000 lit. / day

STROKE NO.	STROKE TIME (sec.)	STROKE NO.	STROKE TIME (sec.)
1	83	26	76
2	74	27	85
3	68	28	66
4	68	29	64
5	63	30	66
6	69	31	71
7	67	32	69
8	65	33	71
9	73	34	73
10	91	35	67
11	84	36	70
12	79	37	71
13	63	38	73
14	52	39	72
15	47	40	71
16	57	41	151
17	35	42	105
18	45	43	89
19	56	44	85
20	77	45	83
21	68	46	80
22	60	47	63
23	75	48	49
24	75	49	50
25	76	50	45

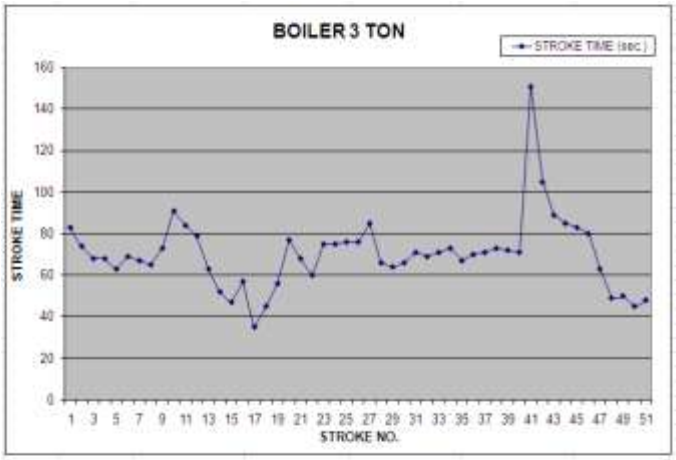

Chart 10 Stroke time v/s stroke no.

Observation

Observation table of averages of all theabove readings.

Table 11 Observation Table

Sr. No.	Date	Time	Avg. Stroke Time (sec.)
1	9/1/2012	11.30 AM – 12.30 PM	117
2	14/01/2012	10.15 AM – 11.15 AM	112
3	14/01/2012	01.45 PM – 02.45 PM	158
4	16/01/2012	10.00 AM – 11.00 AM	95
5	16/01/2012	11.30 AM – 12.30 PM	125
6	16/01/2012	01.45 PM – 02.45 PM	116
7	18/02/2012	10.00 AM – 11.00 AM	80
8	18/02/2012	11.00 AM – 12.00 PM	94
9	18/02/2012	02.15 PM – 03.15 PM	81
10	3/3/2012	10.45 AM – 11.45 AM	70

Total Avg. Stroke Time = 1048 Sec.

Avg. Stroke Time = $\frac{\text{Total Avg. Stroke Time}}{\text{Total no. of Stroke}}$

= $\frac{1048}{10}$

= 104.8 Sec.

Calculations

In plant lot of improvement can be done on the savings sides.

PARAMETERS

Fuel Used = FO

Calorific Value Of Coal = 9650 Kcal / KG

Fuel Consumption = 2400 Kg/Day

FEED WATER TEMPERATURE = 65 ^{0}C

PRESSURE = 7 BAR

BOILER EFFICIENCY = 80 %

AVERAGE RUNNING HOURS = 24hrs/ day

STEAM TO FUEL RATIO

= $\frac{9650 \text{ X } 0.8}{(660.8-65)}$

= 13

Maximum Steam Generation =13 X 2400

=31200 Kg /day = 1300 Kg/ hr

With present fuel consumption the boiler is generating steam of 1300 kg/hr.

CONDENSATE RECOVERY

Q = Quantity of condensate being considered for return Max
= 1300 Kg / hr.
T1 = Avg. of feed water temperature
= 65^{0}C.
T2 = Ambient temperature
= 30 ^{0}C.
η = Boiler efficiency
= 0.80.
C = Calorific value of fuel
= 9650 Kcal / Kg.
F = Landed cost of fuel
= Rs. 40 / Kg.
T = Plant operation
= 24 Hrs. / day.

Why To Return Condensate?

An effective condensate recovery system collects the hot condensate from the steam using equipment and returns it to the boiler feed system. It can rapidly pay for itself in reduced fuel costs alone.

The graph here illustrates the heat content of steam.

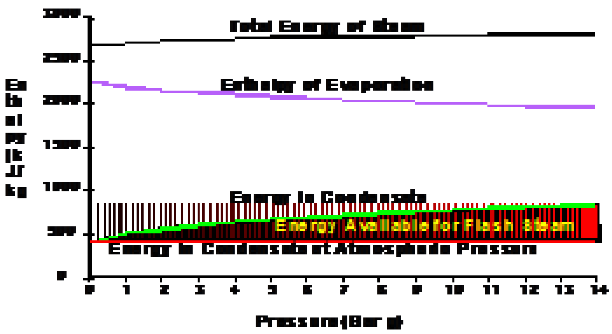

Chart 11 heat content of steam

SAVING DUE TO CONDENSATE RECOVERY

HEAT SAVING= 1300 (65 - 30)

= 45500 K.cal /hr.

FUEL SAVED=Heat saved
Calorific value of fuel x Boiler efficiency
= 4550
9650 X 0.80

= 5.89 Kg / Fuel per hr.

Considering 24 hrs. working in a day.

SAVING
= 5.89 X 24 = 141.36 Kg / day.

Considering 300 working days in a year.

= 141.36 X 300 =42408 kg / year

Fuel cost saving in rupees.

= 42408 X 40 = 1696320 Rs/-

WATER SAVING

During each stroke 30 lit. Water is used

Water saving in lit. / day.
= 30 X 24 X 60 X 60
104.8
= 24732.82 lit. / day.= 24.732 k lit. / Day.

Water cost saving in Rs

Cost of industrial water is 9 Rs./ K lit.

Cost saving of industrial water = 24.732 X 9

= 233.28 Rs. / day.

TOTAL SAVINGS ACHIEVED

=1696320 Rs/-

TOTAL INVESTMENT

Investment For Condensate Contamination Detection System

Table 12 Investment for condensate contamination detection system

Sr. no.	Size	Unit rate	Qty.	Total
1	40NB	410000/-	1	410000/-

INVESTMENT FOR CONDENSATE RECOVERY SYSTEM

SR. NO.	SIZE	UNIT RATE	QTY.	TOTAL
1	No.8	110000/-	1	110000/-

Table.13 Investment for condensate recovery system

INVESTMENT FOR FLASH VESSEL

Table 14 Investment for flash vessel

Sr. no.	Size	Unit rate	Qty.	Total
1	40 NB	180000/-	1	180000/-

OTHER INVESTMENT

Investment for Pipeline = Rs 250000/-
Investment for Civil Installation = Rs 150000/-
INVESTMENT = Condensate Contamination Detection System + CONDENSATE RECOVERY SYSTEM + Flash Vessel + Pipeline + civil installation =410000 +180000 +110000 + 200000 + 100000

TOTAL INVESTMENT= Rs 1000000/-
TOTAL SAVINGS = Rs 1696320/ year.

PAYBACK PERIOD CALCULATIONS

Payback period =(investment/savings) X 12 Months= (1000000/ 1696320) X 12**= 7Months**

Hence according to project recovery is in 7 months.

ADDITIONAL SAVINGS

1.Savings in your huge electric consumption.

2. Savings in boiler water treatment.

RESULT andDISCUSSION

We have suggested recovering the condensate from Pickling section and pump it to feed water tank, changes will help you in huge savings in fuel bill long with savings in electric energy and boiler water treatment costto counter this problem we propose a **Condensate Contamination Detection System.** With the installation of our CCDS and Steam operated pump you will be able to recover condensate at 66^{0}C thus helping in energy conservation and enhancing the overall efficiency as a whole. By this u will be able to save Rs.1696320/-
This complete system will give you an attractive pay back of 7 months with an complete investment of Rs.1000000/- and offering you savings of Rs.1696320/-

Conclusions

Thus concluding the project it is seen that following savings can be achieved by installing the condensate recovery system.

Financial Savings

Condensate is a valuable resource and even the recovery of small quantities is often economically justifiable. The discharge from a single steam trap is often worth recovering. Un-recovered condensate must be replaced in the boiler house by cold make-up water with additional costs of water treatment and fuel to heat the water from a lower temperature.

Water Savings

Any condensate not returned needs to be replaced by make-up water, incurring further water charges from the local water supplier.

Maximizing Boiler Output

Colder boiler feedwater will reduce the steaming rate of the boiler. The lower the feedwater temperature, the more heat, and thus fuel needed to heat the water, thereby leaving less heat to raise steam.

Boiler Feed Water Quality

Condensate is refined water, which contains no aggregate total dissolved solids (TDS). Boilers should be blown down to decrease their centralization of broke down solids in the kettle water. Returning more condensate to the food tank lessens the requirement for blow down and in this way diminishes the vitality lost from the kettle.

Monetary Value

Condensate is such a valuable resource that the recovery of even relatively small quantities is economically justifiable. Even the discharge from a single steam trap is often worth recovering.

Future work

In future by installation of condensate recovery system we can achieve maximum profit and savings. We can also save the electricity hence energy. We also reduce fuel and water charges by installation of condensate recovery system.

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