BEWARE ON MIXED FUEL CALCULATION USED IN BOILER PERFORMANCE TEST

HOW TO CHECK CORRECTNESS OF MIXED FUEL CALCULATION

NOTE: Fuel Mixing Ratio (Weight Ratio OR Heat Ratio) Should be Same in Boiler Performance Test w.r.t. Design Mixing Ratio to get the correct results

BOILER ANALYSIS OF PROJECT CASE -1

Slop Fired, Travelling Grate Boiler, Design Fuel - BAGASSE & SLOP

III.A. DESIGN FUEL ANALYSIS (ULTIMATE)				
Fuel	**Units**	**Analysis of Bagasse (By weight)**	**Analysis of Spent Wash (By weight)**	**Slop +Bagasse**
Carbon	%	23.50	19.20	20.60
Hydrogen	%	3.25	2.10	2.48
Oxygen	%	21.75	16.50	18.21
Sulphur	%	0.00	1.05	0.71
Nitrogen	%	0.00	1.85	1.25
Moisture	%	50.00	40.00	43.26
Ash	%	1.50	19.30	13.49
Total	%	100	100.0	100.0
Gross calorific value	Kcal/kg	2272	1584	1808

In Above Calculation, Mix Fuel Analysis (Bagasse + Slop) done at Weight Ratio 32.5% & 67.5%

VI. PERFORMANCE TEST FUEL ANALYSIS (ULTIMATE) AS PER LAB & SITE MEASURED REPORT :-						
FUEL	**Units**	**Analysis of Bagasse (By weight) As per Lab Report**	**Analysis of Bagasse (By weight) (Analysis corrected on site moisture)**	**Analysis of Spent wash (By weight) As per Lab Report**	**Analysis of Spent wash (By weight) (Analysis corrected on site moisture**	**Slop +Bagasse(As per Correced Lab Report)**
Carbon	%	22.15	20.89	19.43	20.83	20.85
Hydrogen	%	3.57	3.37	2.24	2.40	2.70
Oxygen	%	28.25	26.64	19.48	20.88	22.63
Sulphur	%	0.04	0.04	0.5	0.54	0.38
Nitrogen	%	0.42	0.40	1.45	1.55	1.20
Moisture	%	43.90	47.10	43.1	39.00	41.47
Ash	%	1.67	1.57	13.8	14.79	10.77
Total	%	100.0	100.0	100	100.0	100.0
Gross calorific value	Kcal/kg	2235	2108	1547	1658	1795

In Above Calculation, Mix Fuel Analysis (Bagasse + Slop) done at Weight Ratio 30.5% & 69.5% In-Place of 32.5% & 67.5%. THIS DIFFERENCE will Impact on FINAL TEST CALCULATION as below

SNO	Correction thermal effciency due to variation of	As per contract	As per PG test	Correction in effciency%
1	Hydrogen in fuel %	2.48	2.70	0.71
2	Moisture in fuel %	43.26	41.47	-0.65
3	GCV kcal/kg	1808	1795	0.04
4	Ambient temperature (°C)	30.00	32.80	-0.19
5	Excess air correction (%)	40.00	38	-0.10
6	Relative Humidity %	70.00	82.00	0.04
7	Flue gas temperature at air heater outlet (°C)	190.00	218.76	1.38
8	Net correction in efficiency (%)			1.23

In Above Calculation, Difference Benefit of Improper Weight Ratio (2%) in Mix Fuel Analysis (Bagasse + Slop) taken. ALWAYS CHECK DETAILED CALCULATION & ANALYSIS DON'T TRUST

BOILER ANALYSIS OF PROJECT CASE -2

Slop Fired, Travelling Grate Boiler, Design Fuel- BAGASSE & SLOP

III.B DESIGN FUEL ANALYSIS (ULTIMATE)				
Fuel	Units	Slop	Bagasse	Slop + Bagasse
Carbon	%	22.22	23.50	22.86
Hydrogen	%	2.15	3.25	2.70
Oxygen	%	14.50	21.75	18.14
Sulphur	%	0.62	0.00	0.31
Nitrogen	%	1.85	0.00	0.92
Moisture	%	40.00	50.00	45.02
Ash	%	18.66	1.50	10.04
Total	%	100.0	100.0	100.0
Gross calorific value	Kcal/kg	1700	2272	1987.3

In Above Calculation, Mix Fuel Analysis (Bagasse + Slop) done at Weight Ratio 50.2% & 49.8%

VI. PERFORMANCE TEST FUEL ULTIMATE ANALYSIS (by weight) AS PER LAB REPORT :-					
FUEL	Units	Bagasse (As per Lab Report)	Bagasse (corrected to site moisture)	Slop	Slop + Bagasse
Carbon	%	25.38	24.67	20.34	21.83
Hydrogen	%	3.58	3.48	2.78	3.02
Oxygen	%	23.57	22.91	19.74	20.83
Sulphur	%	0.06	0.06	1.00	0.68
Nitrogen	%	0.07	0.07	1.73	1.16
Moisture	%	46.47	47.96	45.11	46.09
Ash	%	0.87	0.85	9.30	6.40
Total	%	100.00	100.00	100.00	100
Gross calorific value	Kcal/kg	2280	2217	1892	2003

In Above Calculation, Mix Fuel Analysis (Bagasse + Slop) done at Weight Ratio 34.0% & 66.0% In-Place of 50.2% & 49.8%. THIS DIFFERENCE will Impact on FINAL TEST CALCULATION as below

S.No	Correction thermal efficiency due to variation of	As per Contract	As per PG test	Correction in Efficiency , %
1	Hydrogen in fuel %	2.70	3.02	0.94
2	Moisture in fuel %	45.02	46.09	0.35
3	GCV kcal/kg	1987	2003	-0.11
4	Ambient temperature (°C)	30.00	21.24	0.87
5	Net correction in efficiency (%)			2.05

In Above Calculation, Difference Benefit of Improper Weight Ratio (16.2%) in Mix Fuel Analysis (Bagasse + Slop) taken. ALWAYS CHECK DETAILED CALCULATION & ANALYSIS DON'T TRUST

BOILER ANALYSIS OF PROJECT CASE -3

Slop Fired, Travelling Grate Boiler, Design Fuel- COAL & SLOP

III.A. DESIGN FUEL ANALYSIS (ULTIMATE)				
Fuel	Units	Analysis of Coal (By weight)	Analysis of Spent Wash (By weight)	Slop + Imported Coal
Carbon	%	42.10	20.36	27.00
Hydrogen	%	3.23	1.97	2.41
Oxygen	%	19.30	13.30	15.65
Sulphur	%	0.12	0.56	0.50
Nitrogen	%	0.45	1.70	1.51
Moisture	%	28.08	45.00	37.13
Ash	%	6.72	17.11	15.79
Total	%	100	100	100.0
Gross calorific value	Kcal/kg	3812	1750	2246

In Above Calculation, Mix Fuel Analysis (Coal + Spent Wash) done at Weight Ratio 33.8% & 66.2%

VI. PERFORMANCE TEST FUEL ANALYSIS (ULTIMATE) AS PER LAB REPORT :-				
FUEL	Units	Analysis of Coal (By weight)	Analysis of Spent wash (By weight)	Slop + Imported Coal
Carbon	%	41.54	19.58	24.90
Hydrogen	%	3.47	2.56	2.78
Oxygen	%	15.75	16.61	16.40
Sulphur	%	0.95	0.75	0.80
Nitrogen	%	1.35	1.64	1.57
Moisture	%	30.58	50.61	45.76
Ash	%	6.36	8.25	7.79
Total	%	100.00	100	100
Gross calorific value	Kcal/kg	3900.00	1768	2284.15

In Above Calculation, Mix Fuel Analysis (Coal + Slop) done at Weight Ratio 33.6% & 66.4% In-Place of 33.8% & 66.2%. THIS DIFFERENCE will Impact on FINAL TEST CALCULATION as below

SNO	Correction thermal effciency due to variation of	As per contract	As per PG test	Correction in effciency%
1	Hydrogen in fuel %	2.41	2.78	0.96
2	Moisture in fuel %	37.13	45.76	2.48
3	GCV kcal/kg	2246	2284	-0.27
4	Ambient temperature (°C)	30.00	35.43	-0.34
5	Excess air %	45.00	51.28	0.32
6	Flue gas temperature at air heater outlet (°C)	190.00	194.95	0.24
7	Relative Humidity %	70.00	64.00	-0.02
8	Net correction in efficiency (%)			3.36

In Above Calculation, Difference Benefit of Improper Weight Ratio (0.2%) in Mix Fuel Analysis (Coal + Slop) taken. ALWAYS CHECK DETAILED CALCULATION & ANALYSIS DON'T TRUST

FUEL WEIGHT RATIO in BOILER =

Fuel A- Bagasse Quantity -2250 Kg, Fuel B- Slop Quantity -9000 Kg,
Total Fuel Qty = Fuel A + Fuel B = 2250 + 9000 = 11250 Kg

Weight Ratio % in Mixed Fuel for **FUEL A- Bagasse** = (2250 / 11250) x 100 **= 20%**
Weight Ratio % in Mixed Fuel for **FUEL B- Slop** = (9000 / 11250) x 100 **= 80%**

HOW TO CHECK CORRECTNESS OF MIXED FUEL CALCULATION

1. WEIGHT RATIO CALCULATION for GCV:-

Fuel -No. A GCV -100 kcal/kg Ratio in Mix fuel by Weight - 20 %
Fuel -No. B GCV -200 kcal/kg Ratio in Mix fuel by Weight - 30 %
Fuel -No. C GCV -300 kcal/kg Ratio in Mix fuel by Weight - 50 %

Average GCV of above Mixed Fuel for Total 100% = {No.A Ratio (20%) x No.A GCV (100)} + {No.B Ratio (30%) x No.B GCV (200)} + {No.C Ratio (50%) x No.C GCV (300)}

= (20/100 x100) + (30/100 x200) + (50/100 x300) = **230 Kcal/kg for Mixed Fuel**

2. WEIGHT RATIO CALCULATION for FUEL ANALYSIS:-

Average Fuel Analysis of above Mixed Fuel =

Composition%	Fuel No.A x 20%	Fuel No. B x 30%	Fuel No.C x 50%	Mixed Fuel %
Carbon	23.5 x 20/100 = 4.7	28.5 x 30/100 = 8.55	33.5 x 50/100 = 16.75	30
Hydrozen	3.25 x 20/100 = 0.65	2.03 x 30/100 = 0.609	2.10 x 50/100 = 1.05	2.309
Nitrogen	AS ABOVE	AS ABOVE	AS ABOVE	
Sulphur	AS ABOVE	AS ABOVE	AS ABOVE	
Moisture	AS ABOVE	AS ABOVE	AS ABOVE	
Ash	AS ABOVE	AS ABOVE	AS ABOVE	
Oxygen	AS ABOVE	AS ABOVE	AS ABOVE	
TOTAL	100	100	100	100

Put Mixed Fuel Value in Efficiency calculation as mixed fuel analyse composition

3. LAB CORRECTION CALCULATION for FUEL ANALYSIS:-

Fuel -No. A Lab report Moisture - 45% Design Fuel Moisture - 50%

1. Lab report moisture conversion to Design fuel moisture =
(100 - Design fuel moisture) / (100 - Lab report Moisture) = (100-50) / (100-45) = **0.909**
i.e. Multiply all Fuel composition by factor 0.909

2. Design fuel moisture conversion to Lab report moisture =
(100 - Lab report Moisture) / (100 - Design fuel moisture) = (100-45) / (100-50) = **1.1**
i.e. Multiply all Fuel composition by factor 1.1

REPORT CORRECTION @ 45% Moisture

Composition%	**Lab Report - Corrected to Design**		**Design Report - Corrected to Lab**	
Carbon	26.4	26.4 x 0.909 = 24.00	23.5	23.5 x 1.1 = 25.85
Hydrozen	4.56	4.56 x 0.909 = 4.15	3.15	3.15 x 1.1 = 3.47
Nitrogen	0.2	0.2 x 0.909 = 0.18	0.2	0.2 x 1.1 = .11
Sulphur	0.02	0.02 x 0.909 = 0.02	0.1	0.2 x 1.1 = .22
Moisture	45	50	50	45
Ash	0.58	0.58x 0.909 = 0.53	1.3	1.3 x 1.1 = 1.43
Oxygen	23.4	23.4 x 0.909 = 21.27	21.75	21.75 x 1.1 = 23.93
GCV	2722	2722 x 0.909 = 2474.5	2272	2272 x 1.1 = 2499.2
TOTAL	100	100	100	100

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Regards

Pramesh Kumar Jain
Chief Executive- Technical

Mb +91 9555082622, +91 9868499319

Unite Energy Corporation LLP, Ghaziabad, UP
pramesh.uniteenergy@gmail.com
uniteenergycorp@gmail.com