RANKING OF PALEOCENE AGE COAL SALT RANGE, PUNJAB AND ITS APPLICATION IN COAL FIRED POWER PLANTS

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ABSTRACT: *Proximate analysis from coal of Paleocene age has been tested for their determination of its rank. Numbers of coal samples were collected from various underground coal mines located at Wahula Dandot and Padhrar in Salt Range. These samples were tested by applying standard method for the determination of moisture contents, ash contents, volatile matter, fixed carbon, sulfur and gross calorific value. The results indicate that all the values lies within the rank of Lignite; however the values of moisture content are lower than lignite. A comparison has been made of our result with the market demand which show its suitability of the salt Range coal for Coal Fired Power Plants (CFPP).*

Key words: Coal Ranking, Punjab Coal, Paleocene age, Coal Fired Power Plant

INTRODUCTION

Pakistan has large coal reserves but the deposits need to be exploited for provincial and national development. Coal resources and their discoveries are necessary in order to meet increasing demands of energy. Pakistan is ranked 7th internationally regarding lignite coal reserves. Whereas in Pakistan many coal fields remain under developed. Like other provinces of Pakistan Punjab also have large coal deposits. Permian and Paleocene are two main horizons for coal in Punjab [1]. Warwick and Shakoor reported that Patala coal is found in Salt Range mostly in the Chakwal and Khushab and Hangu coal is found in Makerwal, Surghar and Orakzai [2].

The present study is related to the coal from two district of Khushab and Chakwal. Padhrar Coal project (PCP) in Khushab where as Dandot Coal project (DCP) and Wahula Coal project (WCP) lies in Chakwal district.

Many investigators have worked on the coal quality estimation from Salt Range, Punjab province such as Irshad et al [3] studied the characterization of Khushab coal, Fazeelat and Asif [4] investigate the Geochemical study of Lignite coal from Pakistan, Ahmad et al [5] work on the coal resources of Pakistan where as Khan et al [6] reported the coal quality with reference to the Acidic Mine Drainage, Malkani *et al* [7] worked with reference to coal of Baluchistan, Mehmood et al [8] studied the underground coal gasification properties of Chakwal coal and Ismat [9] look into coal briquetting process etc.

This investigation has been carried out to estimate the quality of coal in the Salt Range, Punjab province, Pakistan for its application in Coal Fired Power Plant. This study has been performed in the Department of Geological Engineering, UET Lahore. Lahore as a part of M. Sc research by principal author, registration number (2011-MS-GS-11) and partial results are being published in this paper.

Methodology

Standard procedures of ASTM [10] were applied for the collection of coal samples and the determination of the parameters such as moisture content, ash, volatile matter, fix carbon, sulfur and gross calorific value.

RESULTS AND DISCUSSIONS

Proximate analysis covers the percentage of moisture contents, volatile matter, ash contents and fix carbon .Thus it is important to both the suppliers and users of coal to have a rapid, accurate and reliable procedure to obtain this analysis which quantify the quality of coal.

Lab analysis of Wahula coal project (Tab.1) shows that the percentage of total moisture and ash contents ranges from 4.72 % to 5.86 % and 34.29 % to 50 % respectively which lies within range and good for its utilization in Coal Fired Power Plants. . However the other parameters such as volatile matter and fix carbon are lies within the limits of the suitability for coal fired power plants.

The results of coal analysis performed for Padhrar Coal Project (Tab.2) indicates that the results of volatile matter ranges from 29.32 to 31.4% in the northern area of PCP where as it is 23.28 to 24.41% in the southern part.

The total moisture content is 4.5% to 5.83%; however there is a great variation in the ash contents which varies from 33.67% to 50.34% which indicates that there is a high variation in ash content which is probably due to depositional environment. However the other parameters such as moisture content and fix carbon are lies within the limits of the suitability for coal fired power plants.

The approximate analysis for Dandot Coal Project (Tab.3) shows that the value of volatile matter varies from 19.91 to 33.03%. The DCP is divided into two sub sections (Ghambrala and Minhala). The Ghambrala section of DCP contains high volatile matters than Minhala section. The percentage of total moisture of DCP is normal and range from 4.62% to 9.28%. The coal deposit of DCP comprises high ash contents range from 27.95% to 63.21%. . However the other parameters such as ash and fix carbon also lie within the confines of the suitability for coal fired power plants.

This graphical representation (Fig.1) gives comparison of three coal projects which shows that the coal reserves of Wahula Coal Project is comparatively better than Padhrar and Dandot Coal Projects.

Tab-1: Proximate analysis of Wahula Coal Project from Salt Range

Sr. No.	Identification		Moisture Contents %	Ash contents %	Volatile Matter %	Fix Carbon %
1	PW-1	1	5.91	51.26	24.6	18.76
		2	5.79	50.29	24.37	18.35
		3	5.89	51.2	24.45	18.45
	Avg. Value		**5.86**	**50.91**	**24.47**	**18.52**
2	PW-1 (Coal+Prat)	1	4.89	34.22	34.72	28.23
		2	4.73	34.18	34.68	28.34
		3	4.84	34.49	34.83	28.54
	Avg. Value		**4.82**	**34.29**	**34.74**	**28.37**
3	Mine 18 (Coal+Prat)	1	4.95	44.46	31.03	21.45
		2	4.73	44.38	30.98	21.39
		3	4.54	44.42	31.28	21.27
	Avg. Value		**4.74**	**44.42**	**31.09**	**21.37**

Tab-2: Proximate analysis of Padhrar Coal Project from Salt Range

Sr. No.	Identification		Total Moisture Contents %	Ash contents %	Volatile Matter %	Fix Carbon %
1	PCP 1 Shaft A	1	4.75	40.65	29.09	28.70
		2	4.57	40.35	29.3	28.13
		3	4.29	40.01	29.76	27.97
	Avg. Value		**4.53**	**40.33**	**29.383**	**28.26**
2	PCP 1 Shaft B	1	5.68	38.4	30.02	25.89
		2	5.57	38.28	30.36	25.34
		3	5.72	38.53	29.96	25.73
	Avg. Value		**5.65**	**38.403**	**30.113**	**25.65**
3	PCP 1 Fresh New Incline	1	5.99	33.96	31.4	28.68
		2	5.84	33.6	31.8	27.99
		3	5.67	33.45	31	29.01
	Avg. Value		**5.83**	**33.67**	**31.4**	**28.56**
4	PCP 1 New Inclined Stock	1	4.98	36.91	31.2	26.91
		2	4.46	36.8	31.45	26.65
		3	4.76	36.23	31.55	26.43
	Avg. Value		**4.73**	**36.646**	**31.4**	**26.66**
5	PCP 1 Fresh Shaft A	1	5.94	47.44	23.75	22.87
		2	5.45	47.59	23.83	22.78
		3	5.39	47.35	23.12	22.43
	Avg. Value		**5.59**	**47.46**	**23.566**	**22.69**
6	PCP 2 Shaft A 1000 Tons	1	4.49	50.93	23.47	21.15
		2	4.23	50.2	23.29	21.09
		3	4.78	49.9	23.1	20.94
	Avg. Value		**4.5**	**50.343**	**23.286**	**21.39**
7	PCP-2 Shaft A Fresh	1	4.47	49.96	24.41	22.03
		2	4.87	49.14	24.19	22.34
		3	4.73	49.36	24.63	22.41
	Avg. Value		**4.69**	**49.486**	**24.41**	**22.26**

Tab-3: Proximate analysis of Dandot Coal Project from Salt Range

Sr. No	Identification			Moisture Content %	AshContent %	Volatile Matter %	Fix Carbon %
1	Ghambrala Section	PG-9	1	4.61	63.4	19.88	12.31
			2	4.53	62.96	20.12	12.43
			3	4.72	63.12	19.75	12.1
		Avg. Value		**4.62**	**63.16**	**19.916**	**12.1**
2		PG-43	1	7.28	34.61	33.37	24.78
			2	8.19	35.12	32.1	24.81
			3	7.09	34.29	33.63	24.23
		Avg. Value		**7.52**	**34.673**	**33.033**	**24.23**
3		PG-46	1	4.88	60.5	20.29	14.31
			2	5.76	58.1	23.2	14.1
			3	4.21	59.23	21.05	14.34
		Avg. Value		**4.95**	**59.276**	**21.513**	**14.34**
4	Minhala Section	PG-55	1	9.41	28.28	31.74	31.4
			2	9.3	27.63	30.26	31.45
			3	9.15	27.95	32.12	31.6
		Avg. Value		**9.286**	**27.953**	**31.373**	**31.6**
5		PG-5	1	7.13	47.5	22.96	22.86
			2	7.39	47.13	21.55	22.76
			3	7.17	48.29	22.32	22.94
		Avg. Value		**7.23**	**47.64**	**22.276**	**22.94**
6		PG-42	1	5.51	63.72	20.29	11.24
			2	5.23	62.34	20.63	11.75
			3	5.62	63.59	19.39	11.34
		Avg. Value		**5.453**	**63.216**	**20.103**	**11.34**
7		PG-48	1	4.97	50.59	20.81	24.47
			2	4.73	49.6	20.53	24.78
			3	4.63	50.35	20.4	24.34
		Avg. Value		**4.776**	**50.18**	**20.58**	**24.34**

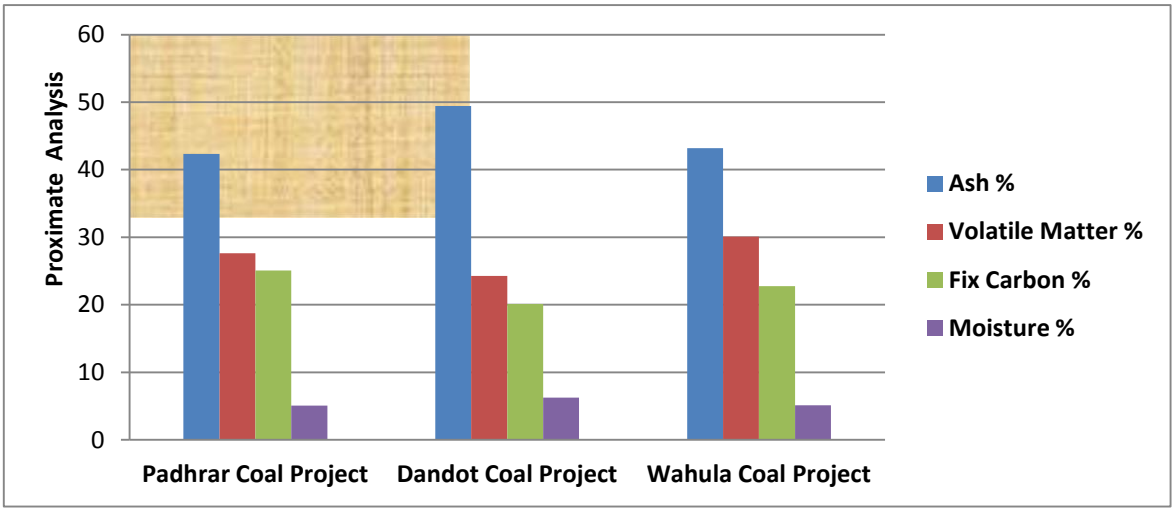

Fig. 1: Graphical representation of Proximate Analysis for overall PCP, DCP and WCP

Tab-4: General Coal classification on the basis of Proximate Analysis [11]

Parameter	Lignite	Bituminous	Semi Anthracite	Anthracite	Present Research	Remarks
Moisture %	15-30	10-15	8-10	5-8	5-6.5	Values of M.C is lower than Lignite
Volatile	25-50	15-25	10-15	5-10	24-30	Lignite
Ash %	30-50	20-30	10-20	3-10	40-50	Lignite
Fix Carbon %	25-50	50-70	70-80	80-95	22-25	Lignite
GCV Kcal/Kg	3000-7500	7500-8000	8000-8500	8500-9000	3000-4000	Lignite

Tab-5: Comparison of local coal with market demand of coal for Coal Fired Power Plants

Parameter	Padhrar Coal	Dandot Coal	Wahula Coal	Market demand by Punjab Govt.
Total Moisture %	4 – 5	5 – 9	4 – 5	10 – 15
Ash %	30 – 40	30 – 50	30 – 50	30 – 35
Volatile Matter %	25 – 30	20 – 30	25 – 30	20 – 45
Sulphur %	6 – 9	5 – 6	4 – 5	5 – 6
GCV Kcal/ Kg	3884	3298	3959	3500 – 5000

The comparison of this research work with general coal classification by proximate analysis is given in (Tab.4), it is clear that the coal reserves of Khushab and Chakwal districts belongs to Lignite type of coal which is suitable for Coal Fired Power Plants including boilers etc.

The overall results of our study for coal (Tab. 5) are compared with market demand [12] which is indicating its suitability to be used for Coal Fired Power Plants.

CONCLUSIONS AND RECOMMENDATIONS

- The coal quality of Punjab province is classified as Lignite on the basis of proximate analysis percentage of Sulfur and Gross Calorific Values.
- The Gross Calorific Value of Punjab province (Khushab and Chakwal) is 3656 Kcal/Kg, but it varies from 2678 to 4443 KCal/Kg which is suitable for Coal Fired Power Plants.
- The coal of Punjab province contains high percentage of volatile matter, ash, and Sulfur ranges from 23.56 to 34.74 %, 40.32 to 63.21 % and 3.91 to 10.4 % respectively which also falls within the suitable limits for Coal Fired Power Plants.
- The percentage of total moisture is proper and better overall for the PCP, DCP and WCP which varies from 4.32 to 9.28 %.
- It is recommended that thermal power plants can be installed based on indigenous coal reserves by blending the Salt Range coal with high graded coal to overcome the energy crises.

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