NEW METHOD FOR REDUCTION OF BURNING SULPHUR OF COAL

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INTRODUCTION

Coal pyrolysis is the key phase in the pyrolysis-combustion cycle because it provides char for the combuster. The behaviour of sulphur compounds during coal pyrolysis is determined by many factors, such as the rank of coal, the quantity of sulphur and the sulphur forms distribution in the coal, the quantity and kind of mineral matter and the condition in which the process is conducted(1,2). The mineral matter in coal may inhibit or catalyse the formation of volatile sulphur compounds(3). Pyrolysis can be considered as a means of removing both inorganic and organic sulphur. As a result a portion of the sulphur remains in the char, while the other moves into the tar and gas.

The objective of research described in this study was to obtain an optimal reduction of burning sulphur in coal pyrolysis by variation of different parametric conditions.

RESULTS AND DISCUSSION

The desulphurization by pyrolysis of a series of coal has been studied (Table 1). The samples (100 g) with particle size < 10 mm were heated gradually at the temperature 300-450^{0}C, at atmospheric pressure, and the heating rate of 6-50^{0}C min^{-1}.The samples were treated with ,exhaust gas, nitrogen or their mixtures and addition of steam and air in the process of " pyrolysis -desulfurization". The char obtained remains 1-10 minutes at final temperature. In this condition the char sample cools without a contact with air.

Figure 1 is a principle scheme of apparatus for our method of coal desulfurization: 1-pump, 2-bottle with compressed gas, 3-generator of exhaust gas, 4-flow meter, 5-steam-boiler, 6-contact-thermometer, 7-thermo-regulator. Variant "A": 9-vertical, tubular reactor, 8-electric heater, 10-feeder; 11-cover, 12-shutter, 13-hydrocloser. Variant "B": 9-horizontal, turning reactor; 11-cover; 20-beijing; 21-; 22-electric motor. In both variants the reactor(9) are assembled with: a tube furnace(14), thermocouple(15), thermo-regulator(7), cooler(16), condenser(17), flow meter(18), burner(19). The coal sample is feeding - the variant "A"- in the vertical, tubular reactor(9) and in the variant "B"- in horizontal, turning reactor(9), heated by furnace(14) at constant stream of nitrogen or exhaust gas with 35% water stream. The temperature increase with velocity of 6-50^{0}C. min^{-1}.In this conditions the volatile matters abandon the reactor(9), the liquid products condense in the cooler(16) and enter in the scrubber(17), through flow meter(18), throw out in the atmosphere or burn (19) in the furnace(14).

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Table 1

--Coal samples: Sulphur	Moisture W^a, %	Ash A^d, %	Volatile matter V^{daf}, %	S^d,%
--1. Lignite Maritza Iztok (for briquettes)	12.5	20.50	61.4	4.30
2. Lignite Maritza Iztok (energetics)	32.3	34.84	63.2	5.60
3. Lignite Chukurovo	9.89	11.52	58.5	0.93
4. Anthracite Svoge	2.77	18.21	2.40	0.84
5. Anthracite Ukrainian	2.01	8.08	13.6	1.65

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It follow from this work that at all samples occurs a decrease of burning sulphur and a maximal removal efficiency is 83%. For example at a pyrolysis of Maritza Iztok(energetics) lignite, the burning sulphur in the char is only 16% in comparison with the burning

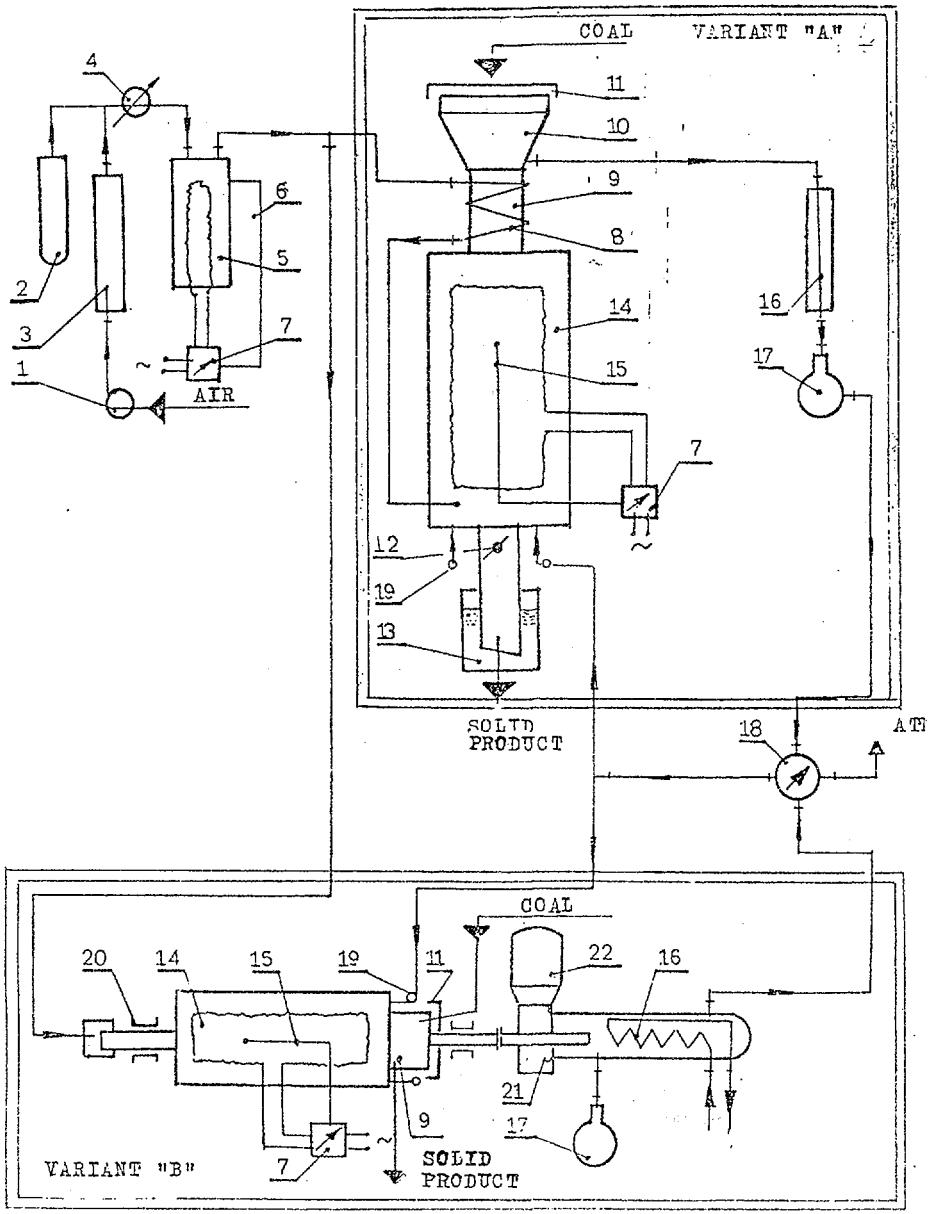

FIG.1 EXPERIMENTAL INSTAL LATION SCHEME

sulphur in the raw coal sample. The remained S total is 90% sulphate, 10%-organic and pyrite-traces when a mixture "exhaust gas-water stream-air" has been used.

Table 2 shows the main characteristics of chars and the method's conditions.

Table 2

					Experimental conditions		
Chars	Moisture	Ash	Volatile	Sulphur	Stream	Tempe rature	Yield
	W^a, %	A^d,%	V^{Dave}, %	S^d,%	*	°C	%
1.Maritza Iztok (for briquettes).	2.1	38.1	42.0	0.74	1*	450	52
2.Maritza Iztok (for energetics)	2.2	54.8	44.6	1.05	1*	450	54
3.Maritza Iztok (for energetics)	2.6	62.4	46.9	0.9	2*	300	55
4.Chukurovo	1.3	21.2	42.8	0.17	3*	450	53
4.Anthracite Svoge	0.9	19.8	-	0.15	3*	450	97
5.Anthracite Ukrainian	1.1	14.3	-	0.32	1*	450	95

1* -exhaust gas + water vapour ; 2* - exhaust gas + water vapour + air; 3* - nitrogen or exhaust gas + water vapour

One promising method for upgrading coal is our method of desulfurization by pyrolysis at different conditions. Char obtained as a clean product can be used for generating electrical power. This innovation is in a stage of patenting /30 August 1997/.

1. Ceylen K. and Olcay A., Fuel Process. Technol. , 1989, 21, 39.

2. Moliner R., Ibarra J. and Lazaro M., Fuel, 1994, vol. 73, No 7, 1214.

3. Douchanov D., Minkova V., Martinez - Alonso A., Palacios J., Tascon J., Erdöl und Kohle, Heft 12, Dezember 1993, 46 Jahrgang, 461.