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OBSERVATIONS OF THE WESTWOOD POLYGAS WOOD WASTE GASIFIER AT CHASM, B.C. DURING THE EXPERIMENTAL CAMPAIGN, JULY 13 TO JULY 24, 1978

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INTRODUCTION

The first campaign of the Westwood Polygas Gasifier at Chasm, B.C. under the financial sponsorship of CANMET (through a Department of Supply and Services contract) was from January 26 to February 2, 1978. The objective of that campaign was to modify and operate the gasifier continuously for five days. In that campaign, a five-day continuous run was not achieved due to a cyclone pump failure caused by excessive fine particulates carried through the system in an upset operating mode. The problem was not so serious that it could not have been corrected under reasonable operating conditions, however, extreme freezing weather during the campaign made correction very difficult. In general, the results were encouraging hence it was decided to continue the work in four phases. The four phases are as follows:

Phase I : To make the necessary modifications on Reactor No. 1 to allow a gas production run for at least one full week. This test is to take raw gas from the reactor and flare it with auxiliary fuel, by-passing the scrubbing/cooling section of the plant.

Phase II : To run the gas plant in total with gas scrubbing and cooling to demonstrate commercial operation which includes delivery of gas to fire one Ainsworth lumber drying kiln.

Phase III: To run Reactor No. 1 utilizing various types of fuel with particular emphasis on municipal solid waste and wood waste, as well as low-grade coal and wood waste.

Phase IV : To modify Reactor No. 2 to make it a full commercial gas producer to supply fuel for the Ainsworth lumber drying kilns on a sustained basis.

Phase I which is the subject of this commentary was from July 13 to July 24, 1978.

CAMPAIGN JULY 13 to JULY 24, 1978

1. Objective

The main objective was to operate the gasifier alone, i.e. without the gas cleaning equipment. The gas produced was incinerated and flared to the atmosphere. This campaign was really a preparatory campaign for the second phase which had for its primary objective the production and utilization of enough clean low-Btu gas to fire one of the lumber drying kilns which are presently being fired with No. 2 furnace oil. Therefore in Phase I as far as gas quality and quantity were concerned the objective was to produce continuously for at least one week gas containing at least 100 Btu's/sdt cu. ft at a rate of at least 4.5 million Btu's/hr. This quantity according to Mr. A. Fernie, Project Manager, would be enough to fire one lumber drying kiln. Also, Mr. Fernie stressed that they felt confident that gas with a much higher Btu content could be produced.

2. Operation of the Gasifier

A schematic diagram of the plant is shown in Figure 1. The reactor, which is a gravitating type is fed at the top, via a rotating valve. Preheated air and steam are introduced at the bottom. The gas produced exits at the top of the reactor and passes through a wet cyclone. In the wet cyclone particulates and tars are removed by a water spray. The wash water is collected in a condensate tank and recirculated. At times when the wood waste was very dry, e.g., when the feed contained much planar - mill shavings, then liquid from the condensate tank was used to moisten the feed before it entered the reactor. The scrubbed gas from the wet cyclone went to the incinerator where it was burnt with air. Propane pilot lights were used to make certain that the gas was always incinerated.

The main objective of the campaign, was far from achieved. The chief reasons why the objectives were not nearly achieved were mechanical failures, and upset conditions. Comments about both are given below.

(a) Mechanical Failures

On two occasions a piece of the sprocket on the rotating hearth broke off and resulted in a seizure of the chain drive. This type of failure required about twelve hours for repairs. On a separate occasion enough fine carbon got through the seal on the rotating hearth that the drive seized. At this time (Friday, July 21st), it was decided to clean the seal and not to restart the reactor until Sunday noon, July 23rd. The reason for this delay was because at the end of the campaign (which was to be July 24th) the reactor was to be shut down and purged and cooled with nitrogen. The nitrogen was scheduled to arrive July 24th at noon, therefore to be certain that the reactor would be in a good operating mode, it was not restarted until July 23rd.

(b) Upset Conditions

On two separate occasions so much finely divided carbon was carried over by entrainment in the gas stream into the condensate tank that, to avoid plugging the pumps that recirculated the condensate liquid, it was necessary to stop the reactor, empty the condensate tank, and refill it with fresh water. Each shutdown lasted about five hours.

In addition to the stoppages caused by mechanical failures and upset conditions, there was one major power shut-down by B.C. Hydro that lasted about six hours, during which time the condensate tank was emptied and refilled. A short log of the operation is shown in Appendix A.

Two members from B.C. Research performed the gas analyses. A summary of the samples taken up to July 21, 1978 are shown in Appendix B. The analyses show that often good quality low-Btu gas was produced. It will be noted that gas analyses were not taken every day because of plant stoppages listed in Appendix A.

Other samples also were taken to determine total particulate and aerosol loading of the gas. These results were not available by the end of the campaign.

SUMMARY

It was not demonstrated that the reactor could produce the desired quality and quantity of gas continuously for seven days. Several prolonged stoppages due to mechanical failures and upset operating conditions were experienced.

RECOMMENDATIONS

This phase of the campaign should be repeated and Westwood Polygas should assume all of the costs. There is no point in continuing on to Phases II, III and IV before the objectives of this phase are met. In addition the following modifications should be considered. The results of the dig-out of the reactor may indicate additional changes.

1. The plant should be thoroughly examined and necessary repairs should be made to ensure that it is in good working order especially the rotating hearth, which had shown some weak spots.

2. Modification of the seal in the rotating hearth to accommodate fine carbon that gets into the sealing medium and results in jamming the rotating mechanism.

3. Modification to the condensate tank so that fine carbon that is generated during so-called upset conditions can be handled rather than having to shut down to clean the tank and put in fresh water.

4. Substitute chips for part of the material fed to the reactor. The wood chips would aid in maintaining porosity and help to stabilize the moisture content of the feed.

   A system whereby units of wood waste could be weighed and sampled before charging should be considered.

5. Pressure probes to monitor the static pressure within and outside the bed in the reactor. This would give an indication of where the pressure is increasing and possibly indicate the reason for the pressure build-up.

6. Investigate the possibility of installing a recording type calorimeter on the gas line before the incinerator. This is not meant to replace the manual gas analyses but it would complement them and also be a useful control tool.

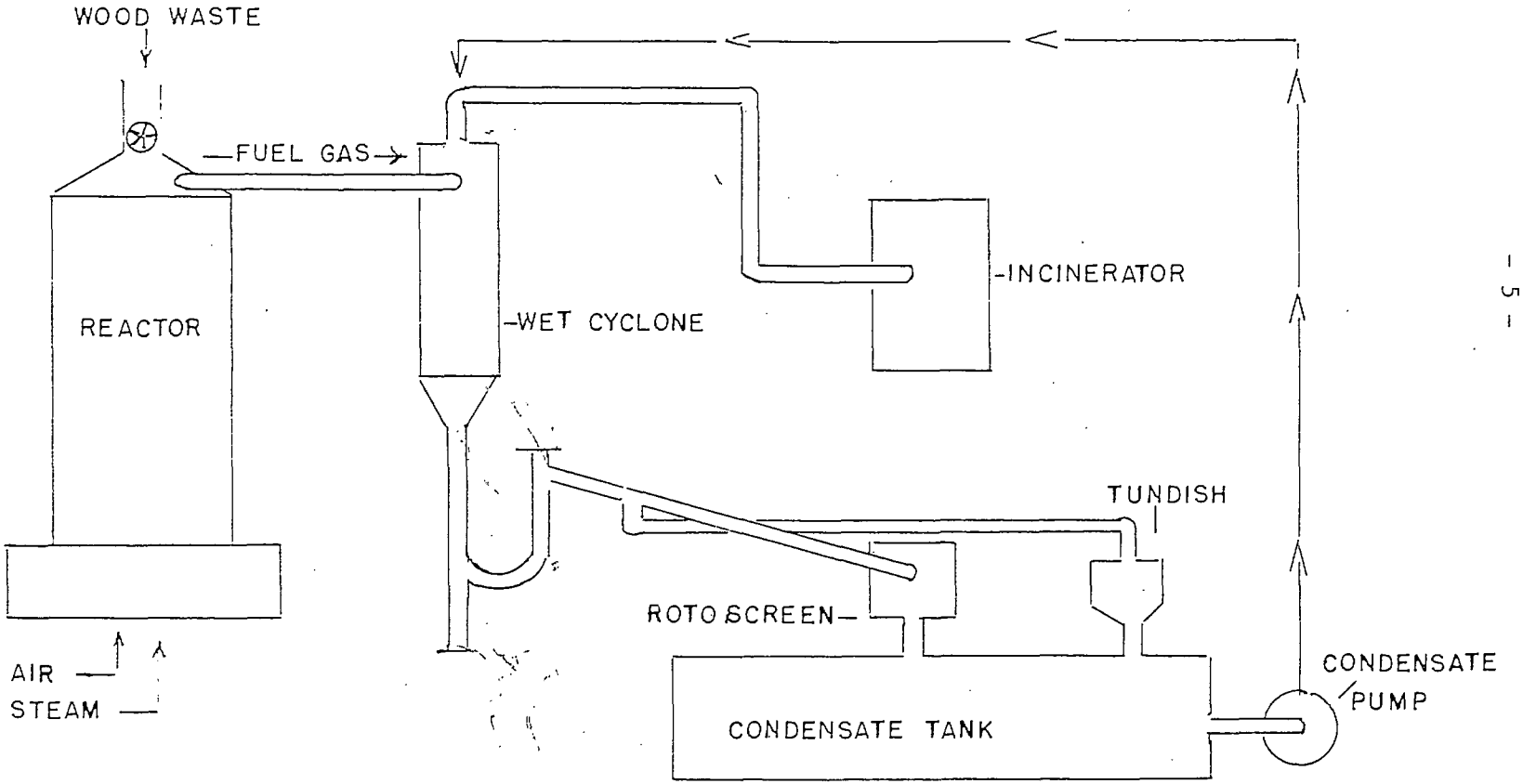

FIGURE 1. Schematic Diagram of the Westwood Plant

APPENDIX A

Summary of the Operation Log

Date	Remarks
July 13 Thursday	Plant started at 18:00 hrs
July 15 Saturday	The feed contained a high proportion of planer shaving and operators claimed the bed fluidized at the higher air rates.
July 17 Monday	Severe upset conditions for some time which resulted in much fine carbon exiting with gas and collecting in the condensate tank. The plant was put on stand-by for 4 hrs while the condensate tank was emptied and refilled with fresh water.
July 19	A piece of the sprocket from the rotating hearth fell off and plant was shut down for about 12 hrs.
July 20	Electric power shut down in the plant from 10:00 hr to 13:30 hr.
	Also condensate tank had a considerable build-up of fine carbon, therefore it was decided to empty the condensate tank and refill it with fresh water. The plant was put on stand-by for about six hrs.
July 21	The chain drive on the rotating hearth seized and the plant was shut down and the seal was cleaned. The plant was not restarted until July 23 at about 12:00 hrs. The reason for the long delay was because at the end of the campaign (which was to be July 24th about 12:00 hrs), the reactor was to be shut down under nitrogen. The nitrogen was scheduled to arrive on July 24th about 12:00 hrs. Therefore it was desirable to have a good operating reactor at that time, consequently restarting was delayed as long as possible.
July 23	Reactor was restarted about 12:00 hrs.
July 24	Another section of the sprocket on the hearth drive fell off about 06:30 hrs. The operation was discontinued.

APPENDIX B

Summary of Gas Analyses

Date (July)	Time	Sample No.	H_2	O_2	N_2	CO_2	CO	CH_4	C_2H_2	C_2H_4	C_2H_6	Btu's cu ft	Remarks
17	15:30	1	18.8	-	39.8	13.2	20.2	3.1		0.8		171	
17	18:00	2	16.2	1.25	49.7	18.8	9.7	2.43		0.49		117	Condensate tank wa emptied and refil-
17	18:50	3	16.5	-	47.3	16	13.4	2.3		0.43		128	
17	19:50	4	18.3	0.24	40.5	12	19.4	2.56		0.34		153	led in the morning.
18	09:30	5	13.7	0.34	46	5.1	28.6	1.38		0.17	0.11	155	
18	10:35	6	15.6	-	45.5	5.6	29.4	1.79		0.18	0.12	168	Sprocket broke off
18	11:30	7	20.4	-	37	10.3	24.4	2.27		0.14	0.16	173	July 19. Shut down
18	13:20	8	11.2	-	42.5	15.3	19.6	2.75		0.34	0.34	139	for about 12 hrs.
18	14:55	9	14.1	-	53	8.3	19.2	2.72		0.2	0.16	141	
20	07:05	10	1.0	2.98	65	16	13.3	1.15		0.11	0.11	61.5	
20	07:40	11	9.1	-	55.3	6.4	25.2	1.86		0.072	0.12	133	Power off at 09:00
20	08:15	12	20.4	-	43.2	8.0	23.6	3.93		0.56	0.23	195	hrs. Condensate
20	09:15	13	6.3	1.44	62	12.4	16	1.86		0.49	0.14	182	tank also emptied.
20	10:00	14	1.8	5.8	67.7	8.3	11.6	1.15		0.34	0.09	64	Plant restarted at
20	20:40	15	3.6	0.77	58.6	15.6	18.2	1.54		0.17	0.16	92	15:30 hrs.
20	21:10	16	4.3	-	56	14.7	18.4	1.39		0.12	0.14	92	
21	10:15	17	2.2	2.3	59.7	11.5	16.0	1.21		0.24	0.12	77	
21	11:10	18	6.7	tr	52.6	13.1	18.2	2		0.5	0.14	114	
21	11:50	19	5.2	1.2	57.5	11.8	16.8	1.44		0.39	0.11	94	
21	12:20	20	2.1	1.2	63.2	13.9	13.2	0.67				58	
21	15:10	21	5.1	1.53	58.8	12.0	18.3	1.6	0.17	0.35	0.12	102	The drive on the
21	15:40	22	2.7	2.9	63.7	11.1	16.2	1.01	-	0.17	0.07	75	rotating hearth
21	16:00	23	3.0	3.3	63.7	11.4	15.4	0.96	-	0.13	0.07	72	seized at 18:45 hrs
21	16:30	24	7.8	2.88	62.5	9.4	13.6	0.82	-	0.06	0.06	79	
21	16:50	25	2.0	2.5	64.5	11.8	15.7	0.91	-	.08	.08	69	
21	17:35	26	5.1	-	56.5	14.2	19.2	1.67	-	0.14	0.15	100	
21	18:30	27	4.9	0.3	58	9.1	24.2	1.25	-	0.06	0.08	109	