REPORT
ON
TEST OF "BRONDER"
RETORT FOR
THE
AUSTRALIAN SHALE OIL CORPORATION

Q-37 154

S Jones

589002

REPORT OF MR. STANLEY JONES ON TEST OF BRONDER RETORT FOR THE AUSTRALIAN SHALE OIL CORPORATION.

Hobart, January 1927.

LIBRARIAN

Sirs,

Following on my preliminary report, I beg to submit my final report as follows :-

Discussing first of all the test run in further detail:- The throughput of shale per day was as follows :-

	Tons.	
Tuesday I4th	Nil	Getting up Heats.
Wednesday I5th	26.5	
Thursday I6th	30.5	
Friday I7th	37.2	
Saturday I8th	49.2	
Sunday I9th	47.0	
Monday 20th	49.2	
Tuesday 2Ist	52.I	
Wednesday 22nd	48.9	
Total	300.6	

Retort shut down Wednesday, II.30, 22nd.

It was Thursday, the I6th., before full working temperatures were attained, and the retort had settled down to constant conditions, some delay being caused through slight clinkering of the grate, which occurred through the presence of some residual air in the system, which had not been driven out. I must point out that losses occurred in this respect, owing to having to charge all the main condensers and scrubbing towers with gas before normal operations could be started . No account had been taken in the results of the oil lost in this manner. Minor troubles like these, however, are usually inseparable from the starting up of any distructive distillation plant.

Unfortunately, on Thursday afternoon a further mishap occurred, the clutch having accidently slipped out on one of the discharging conveyors at the base of the retort, and the foreman did not notice it until the trough was filled and the conveyor was jammed. The end plate had to be taken off, and the spent shale raked out, before the conveyor could be freed and normal operations resumed.

From then on however, the retort worked smoothly and consistently until shut down, giving an almost uniform throughput of approximately 50 tons per day.

Taking all these factors into consideration, therefore, it is my opinion that the retort, in constant work, should show a better result in regard to the production of oil per ton of shale, than the test shows.

Regarding the production of oil, the following figures show the results, as summed up at the end of the test, after the oils had all been collected and pumped into one or other of the tanks.:----

(1)

589003

2165

	Before Test.	Galls.	After Test. --Temp.correction	
Storage Tank..... ....37.I36--20% water		29,709	48,998--22½% wat. ---sludge at bottom.	37,I58
No.I Measuring tank.... 4,5I3--I5% "		3,837	5,860--I0% "	4,6I2
No.2 do do .... oil/		------	2,600--45% "	I,430
Naptha Recovery ~~tank~~/.. I,500--60% "		600	I,04I--30% "	729
Nett Crude Oil.....		34,I46		43,929
Crude Naphtha Top Tank.		--		966
Bottom Tank.....		3,36I		3,532
Filter Box.....		234	3I2--25% "	234
Scrubber Oil.....		386	I,090--60% "	386
Casks in Yard.....		200		I20
Cr. Naphtha in Drums...		40		--
Cr. Oil sent to Emerald.		--		440
Fuel Oil Used.....		--		I,240
	Total Oil	38,367		50,847
				38,367
The production was therefore--gallons.....				I2,480
This would give over the whole run---- I2,480 / 300.6			- 4I.5 galls. per ton.	

As the large storage tank, when measured after the test, was being steamed to aid the separation of water, it was necessary to correct the volume for temperature. This was IIOF., and resulted in a minus correction amounting to 8I6 gallons.

The only figure there can be any doubt about in the foregoing is the amount of water in the oil in the big tank, containing the large bulk of the oil made, and No. I and No. 2 Measuring Tanks. I am ignoring the filter box and scrubber oil, as the quantity is small, and would be about the same both before and after the test.

As a check on this, therefore, I took samples each day of the oil in both measuring tanks, before it was pumped over to the large storage tank, and have subjected these to separation distillation and centrifuging tests in my laboratory at Hobart.

The result of these tests seems to show that the quantity of water remaining in the oil has not been under-estimated.

The oil which passed in and out of No.I tank showed 7% of water, and its volume was 6,08I gallons, or approximately half the total oil produced.

There was , in addition, I,738 gallons of oil condensed and run off at the exhauster, which was practically free from water and which , in fact, was mostly used as fuel oil for firing the retort.

The nett volume of oil from these two sources would therefore be :-

6,08I-----7% water.....	5,655
Exhauster Oil.....	I,738
Nett Volume	7,393

Owing to the pumping operations in connection with the charging of the oil in the scrubbers for the arresting of the benzine, one cannot tell exactly how much oil passed through No.2 tank, owing to its varying water content from day to day, but as near as I could tell it amounted to 8,600 gallons, having a water percentage, according to my tests, of 44%, giving a nett volume of 4,8I6 gallons.

This method would therefore give :

Passed through No.I tank	5,655
Exhauster Oil	I,738
Passed through No. 2 tank	4,8I6
Crude Naphtha made	I,I46
Gallons	I3,355

or $\frac{13,355}{300.6}$ -- 44.4 gallons per ton.

I may say that the samples were taken by a method of my own, designed to give, as far as is humanly possible, a fair average sample of the bulk of the oil in the tanks. I therefore regard the works tests as conservative.

The production of crude naphtha was I,I46 gallons, equal to 3.8I gallons per ton of shale, and I consider this would be much improved by the use of a proper scrubbing oil.

As there is no fractional distillation plant on the works, this oil, (the middle fraction) was not available, and the crude oil had to be used. As this oil contains a fair percentage of constituents which are of no use for the absorption of naphtha, a loss of efficienc results from this.

A greater loss of efficiency occurs through the scrubbing oil getting emulsified, that is, the oil separates into minute globules ccated with water, the mixture being capable of remaining in that state for very considerable periods. This naturally reduces the power of the oil to absorb the naphtha very materially.

With the use of a proper oil with a lighter specific gravity the tendency to emulsify is very greatly reduced.

I obtained a bulk sample of the spent shale, and on subjecting this to test, was unable to detect any combustible volatile matter

As I have said perviously, the principle on which the retort operates is theoretically sound, the green shale being subjected to the lowest temperature, and progressing gradually to regions of greater heat, as the more volatile constituents are given off.

I believe some difficulty was met with at first, owing to the amount of dust travelling forward with the gasses passing off from the retort, but this trouble has, to a large extent, been dealt with.

I would suggest however, that your Chief Engineer should get in touch with Mr. A. A. McIntosh, in charge of the West Melbourne Works of the Metropolitan Gas Co., Melbourne, in regard to the application of his Automatic Pressure Control to the retort. This could be made to perform the double function of governing the vacuum within the retort, and freeing the gas entirely from dust.

I think this device would work very well, if the specific gravity of the dust is sufficient to allow it to sink in water.

This concludes my remarks in regard to the test.

(Sgd.) STANLEY JONES.

SUPPLEMENTARY REPORT BY MR. STANLEY JONES FOR THE AUSTRALIAN SHALE OIL CORPORATION.

Sirs,

In addition to the test of the retort, your Managing Director asked me to go into various other matters, and I beg to report as follows :

SHALE DEPOSIT.

The seam has been proved by boring over an area of 312 acres, in close proximity to the works site, and it averages 5'0" in thickness. Assuming 4" loss in mining, this gives, at 1,500 tons per foot acre, 7,125 tons per acre, or a total tonnage of 2,223,000 which at a consumption of 150 tons per day for 300 working days per year, would last for about 50 years. This is on the Company's freehold land.

All investigations made up to the present by the Government Geologist and others seem to indicate that most of the remainder of the Company's freehold property is shale bearing.

The Government Concession, although not actually proved, is in every likelihood shale bearing, judging by the account of the investigations made by the Government Geologist at Parramatta and Railton, and by private concerns in adjacent areas. One section of this land runs about 4 miles due south from the present freehold by about three-quarters of a mile wide, and the Parramatta section 11 miles long by 1 mile wide.

The mine entrance is in close proximity to the works, being only 200 yards from the site of the crusher.

There is plenty of standing timber on the property, which can be used for mining operations.

WORKS.

The works site is on a level piece of ground close to the western bank of the Mersey River, and is almost ideal for its purpose. It is served by a transmission line carrying power from the Hydro-Electric Station at Waddamanna, and is connected by a railway siding to the main North-Western line. It is about 3 miles from the township of Latrobe.

The layout of the plant both at present and for future extensions is very good, and shows evidence of sound engineering design, ample provision being made for extensions to the various parts of the plant in suitable areas, and everything is arranged to take the best advantage of the site, and to have an orderly method of operation.

It must be realised, of course, that the existing plant is incomplete, and that further retorts must be installed to work on a commercial basis.

It is also absolutely essential to have a properly equipped laboratory and the services of a properly trained analytical chemist otherwise production cannot be controlled, and the plant worked at its best efficiency.

I have gone into the proposed layout for an installation of five retorts with the Chief Engineer, and I consider it should be very satisfactory. An alteration in dimensions of the retort has

been made in this proposal, making the nominal capacity 30 tons per day each. I agree with this, and I should not be surprised if they were found capable of dealing with a larger tonnage.

The reduction in the size of the grate will, I think, enable it to be machanically operated.

Provision is made in this layout for the installation of the fractional distillation plant, and for a cracking plant.

The fractional distillation plant is, of course, essential.

The Cracking Plant is for the purpose of treating the crude oil in such a way as to split up the molecules of the hyrdo-carbons of which it is composed into compounds of a simpler molecular structure, the principle of which, of course, benzine.

I understand the Company is in possession of a tender for such a plant from an ~~American~~ American firm, guaranteeing a recovery of benzine of 55%.

The capacity of the plant is I,00 barrels per day. This is the smallest plant made, and as its capacity is greater than the production of oil, it could be necessary to work it intermittently perhaps alternatively with the distillation plant. This would necessitate rather larger storage tanks.

Reviewing the operations of thex present and proposed plants :

PRESENT | FUTURE.

MINING.

(I) Temporary utilisation of shallow shale for running tests.

(2) Necessity to use narrow Bords on account of shallow reef. Means higher hewing costs.

(3) On cost and mine overhead charges would be practically no greater for a production of 150 tons per day.

(I) Drive down to main body of shale.

(2) Open out on I2 yard Bords and long wall for quantity production. Hewing costs would be reduced very materially.

(3) Additional equipment required :
I00 mine skips
560 cub. ft. air compressor and motor.
I air receiver.
I turntable.
Weighbridge.
New rammers, drills, and pipes.

SHALE HANDLING. MINE MOUTH TO CRUSHER.

(I) Hauled by horse and two men to ground near main storage bin. Has there to be knapped by hand, employing I2 men for an output of 50 tons per day, then has to be loaded into skips, taken to conveyor belt, shovelled on to belt. This was emergency handling for running tests.

(I) Proposal is to haul skips by endless ropes direct from weighbridge at mine-head to crusher hopper, delivery from crusher into main storage bin by means of an elevator and belt conveyor. Storage bin (already erected) delivers into belt conveyor direct from bottom gates. This conveyor carries shale at present to the feed hopper above the present retort. For proposed new retort house it will deliver on to another conveyer at right angles, traversing the new retort house. This conveyor will deposit shale into feed hoppers above all retorts.

RETORTS.

(I) Present retort cylindrical at top 8 ft. 6 in. diam. to square section 8 ft. 6 in. at bottom 2 heater columns; 2 discharge conveyors; 2 pressure blowers; charging hopper with bell.40 ton feed hopper above. Grate surface about 72 sq. ft. Charge capacity I5-I8 tons Three upper connections, and take offs for flue gas. Charging hopper about I ton capacity.

(I) Proposed retort, oblong section right through 5 ft - 6in. x 9ft 9 in. of steel with brick lining I top charging hopper, 5 ton capacity, no bell charging necessary. Grate 4 ft. 6 in. wide opera ted mechanically with single screw discharge conveyor to residue bin. One horizontal brick heater column to each retort with pre-heater section of C.I. pipe and super-heater of carbofrax. Grate area

PRESENT.	FUTURE.
	38 sq. ft. Charge 8-10 tons. Smaller grate should result in more even distribution of heat supplied. Shorter grate bars in better control of discharge, allowing mechanical operation. It is proposed to eliminate the blowers in the hot gas, and use return gas under pressure before heating. Pressure to be given by booster in engine room. In my opinion this is an improvement over existing arrangement.

OPERATORS ON EACH SHIFT.

I Foreman 2 Discharges I Heat Column Attendant. For a throughput of 50 tons per day.	I Charge I Heat column attendant. 2 Dischargers and pony. For a throughput of 150 tons per day. With five reterts going it will be necessary to have a foreman on each shift in general charge of the works.

CONDENSERS, EXHAUSTERS, and SCRUBBERS.

2 Water Condensers. 2 Scrubbers. 2 Measuring Tanks. I Atmospheric Condenser. I Bakers No. 45 Exhauster. I Steam Engine. 2-3 Throw-water pump. 2-3 Throw-oil pumps. 2 Single Stage Centrifugal pumps.	4 Water Condensers. 3 Scrubbers. 2 Measuring Tanks. I Atmospheric Condenser. 3 Exhausters. I Steam Engine. I Electric Motor. 7-3 Throw-oil and water pumps. 2 Large two stage centrifugal pumps. I Single stage centrifugal pump. 2 Expansion chambers for catching oil held in suspension by return gas.

NAPHTHA RECOVERY PLANT.

I Still 2 Heat Exchangers Condensers Coils Separating Boxes Coolers, tanks, pump &c. I Receiver.	I Still 2 Heat Exchangers Condensers, coils, Separating boxes, coolers, tanks pump &c. 2 Receivers.

BOILER PLANT.

2 Steam Boilers.	4 Steam Boilers.

NAPHTHA REFINING PLANT.

2 Crude Benzine Receivers. 3 Steam Stills 2 Acid and Soda Washers 2 Finished Receivers Motors, pump &c.	2 Crude Benzine Receivers 3 Steam Stills 2 Acid and Soda Washers 2 Finished Receivers Motors, pump &c. 6 Extra Receivers for bottoms, acid and soda tars &C. Pumps and motors, acid storage. Steam, benzine, water and oil lines. Filling house and drums for stock.

589009

PRESENT.	FUTURE.

TANKS AND DEHYDRATOR.

I-55,000 gallon conical bottom tank with steam coil.	I-50,000 gallon flat bottom stock tank for dehydrated crud oil ready for stills. I Pipe still dehydrator, condenser and expansion box. 2 Receivers for light and heavy cuts. 2-100,000 gallon stock tanks for cracking oil(5 days supply to cracking plant.) 2-3 Throw pumps.

FRACTIONAL DISTILLATION PLANT.

	2 Oil stills, Condenser boxes &c. 6 Receivers 4 Separators I Bitumen Mixer I Bitumen Barrelling Plant Barrel stock.

CRACKING PLANT.

	I Complete cracking plant, daily output 750 barrels benzine(40 galls.) refined ~~white~~ water whmite.(This includes refining addition to usual plant. 6 Receivers for re-run oil piping pumps electrical connections &c. I Complete Tinning and barrelling plant. I Shipping Platform.

OPERATING COSTS WITH PROPOSED PLANT.

589010 253 9. 172

Assuming 150 tons per day throughput.

OPERATING STAFF.

I. ~~1x~~ Chief Engineer.
I. ~~1x~~ Assistant Engineer and Mine Manager.
I. ~~1x~~ Chemist.
I. ~~1x~~ Draughtsman.
2. ~~2x~~ Clerk (Works)
3. Shift Foremen.

MINING.

Estimated contract price on Bord and pillar system, 9/- per ton to tunnel mouth.

I. Weighbridge Man.
2. Clippers.
2. Loaders at Crusher.

I/2 per ton.

The 9/- per ton covers all operations in opening up the mine, and appears a safe figure as another firm is operating on a contract for mining only at 4/6d. per ton under the Bord and pillar system.

Cost of mining would be materially reduced if the long wall system were permitted.

Crusher capacity, 750 tons per 24 hours. There would be one shift per day handling from tunnel mouth to crusher, and two shifts mining.

Operating crusher, storage and handling crushed shale to hoppers over retorts :

I Crusher Attendant----2 shifts.
I Conveyor Attendant----3 shifts

6d. per ton.

Cost of shale into retort hoppers would therefore be 10/8, or 1.08d. per gallon.

This is reckoning on a return of 41.5 gallons per ton, which figure in my opinion can be exceeded in regular working.

RETORTING CHARGES.

		Per Ton.
I	Charger, 3 shifts, at 15/-	4.0d.
I	Burnerman, 3 shifts, at 15/-	4.0d.
2	Dischargers and Pony, per shift	8.8D.
		16.8

or 0.406d. per gallon.

GENERAL PLANT.

		Cost per day. £	s	d.
3	Men Exhausters and Naphtha Recovery	2-	12-	6
I	" Naphtha Refinery	0-	18-	0
3	" Boiler Attendants	2-	12-	6
6	" Oil stills and Dehydrator	5-	5-	0
2	" Pitch Handlers	I-	8-	0
2	" Benzine Filling	I-	15-	0
2	" Benzine Filling Assistant	I-	0-	0
6	" Cracking Plant	6-	0-	0
2	" Fitters	I-	16-	0
2	" Blacksmiths	I-	14-	8
I	" Striker	0-	15-	0
I	" Carpenter	I-	0-	0
4	" Laborers	2-	16-	0
I	Horse and Dray	I-	5-	0⅞
I	Motor Lorry Driver	0-	15-	0
I	Electrician	0-	17-	6
		32-	10-	2

equal to I.25d. per gallon

	Per Gallon
Natural Benzine Refining	0.25d.
Tinning and Casing, reckoning on 10% recovery	I.00
Boiler Fuel	0.33
Water Supply (cost of pumping from River)	0.01
General Overhead---Melbourne	0.70g

CRACKING PLANT.

(These figures supplied by makers of plant)

General Operating Costs :-	Per Gallon.
(Total recovery, 53% of crude oil put through)	0.398d.
Depreciation and repairs	0.55dd.
Barrelling	0.5d.
Royalty	0.2d.
	I.648d.

	Per Gallon.
Sales Staff	0.45d.
Depreciation on plant	I.00d.
Repairs and Maintenance	0.55d.

Overhead cost at works :
Salaries of staff, £4,502 per annum----2/- per ton or 0.58d. per gallon.

A 11.

589012

174

ELECTRIC POWER.

355 h.p. at £II per horse-power per annum -- £3,905, or 0.5d. per gallon

COST SUMMARY.

	Cost per Gallon
Cost of mining and handling shale into retort house, I0/8 per ton	3.08
Retorting Charges	0.486
Labor on General Plant	I.25
Natural Benzine	I.25
Boiler Fuel and Water Supply	0.34
General Overhead, Melbourne	0.703
Cracking Plant	I.648
Sales	0.45
Repairs, Maintenance and Depreciation	I.55
Staff at Works	0.58
Electric Power	0.5
Total	II.757

VALUE OF PRODUCTS.

	Factor.
6% Natural Benzine at 2Id. per gallon	I26d.
3% Kerosene at I5d. per gallon	45d.
53% Cracked spirit at 2Id. per gallon	III3d.
22% Bitumen at 8d.	I76D.
I6% Less (this is on the high side)	-----
Per I00 Gallons	I460d.
--I4.6d. per Gallon.	

Value of Products	I4.6d.
Costs of Production	II.757d.
Net Return	2.843d.
Bounty	3.5d.
	6.343d.

In this figure no provision has been made for rates and taxes. The amount of income would be :

$$\frac{\text{Tons.} \times \text{Days.} \times \text{Gals. per ton.} \times \text{d.}}{240} = \frac{\text{I50} \times \text{300} \times \text{4I.5} \times \text{6.343}}{240}$$

-- £49,356.

This allows about £I2,000 for sinking fund and depreciation on plant.

This takes no account of the income due to sale of redidue, which would amount to about I00 tons per day.

I would advise until the market is established that this should be sold at a nominal figure, say I0/- to I5/- per ton, as freight charges are very high, and it is better to sell at this price than to have to dump it.

Cost of crushing and bagging should not amounts to more than 2/- to 3/- per ton, which would give an income of about £35 to £60 per day.

On a capital of £350,000, the amount of £49,356 would represent a net return of I4.I per cent.

Should it ~~xxx~~ be possible to sell allthe spent shale a further return of between £I0,500 and £I8,000, according to the price at which it is decided to sell, would give an additional return of between 3% and 5.I5%.

The estimated cost of the additional plant required is as follows:

	£
Retort House	9,625
Natural Benzine Plant Additions	500
Water Supply	I35
Dehydrator	750
Cracking Plant	35,370
Crsuher	785
Transformer, Additional	600
Distillatipn Plant	II,7I9
Exhausters and Towers	4,843
Mine Equipment	4,550
Instruments and Laboratory	I,000
Electrical Wiring	500
Supervision	3,500
Contingencies	2,000
Total	75,877

I understand that the Company has offices both in Melbourne and Sydney. I cannot see the necessity for this, particularly in the present stage of develppment; indeed I consider smoother working would be obtained by having the general office routine situated in Latrobe retaining the Melbourne office in connection with the share register and for Board meetings.

I am given to understand that the cost of the ~~xxxx~~ plant already erected has been much inflated by delays both in the execution of contracts and of certain sections of the work, owing to calls on shares not being made in advance of requirements.

The proposed installation of plant is based on a period of approximately twelve months for construction, but is essential that the work should be carried through without interruption, or otherwise the estimate might be exceeded.

A certain amount of revenue might be obtained during construction, by erecting the distillation plant, Benzine Refining Plant, and storage tanks as soon as possible. Some of the shale obtained during the opening of the mine could then be distilled and treated, when sales of Benzine, Kerosene, and Bitumen could be made, and the stock tanks could be filled in readiness for the operation of the Cracking Plant as soon as this should be completed.

(Sgd.) STANLEY JONES.

589013A.

Q37 No 9.

26-032
V2/2

REPORT
ON
TEST OF "BRONDER"
RETORT FOR
THE
AUSTRALIAN SHALE OIL CORPORATION

Prelim Rep on test of Bronder Retort for Aust. Shale Oil Corpn
by
7 Engineer
30/9/26.

589/2

COPY.

Bronder

000

Bronder Rept

589014 mgr 163

(F)

HOBART,
30th. December 1926

Q37

The Secretary,
Australian Shale Oil Corporation,
Melbourne, VICTORIA.

Sir,

Preliminary Report on test of "Bronder" Retort
for the Australian Shale Oil Corporation.

According to the arrangements made barween us, I went to Latrobe on Tuesday the 14th. inst. to carry out the test of the retort.

I found on investigating the conditions at the Works that it was impossible to make a test of any value in the period first suggested, and consequently the run was carried on till the 22nd. inst. final tank measurements being made, after collection of all the oils in the measuring tanks, on the 24th. inst.

No shale was charged into the Retort on the 14th. inst., and it took till the 18th. inst. to get into full operation. From then on the throughput was nearly constant till the 21st. being 50,48,50 and 53 charges averaging 19½ cwt. on successive days. The total tonnage put through the retort was 300.6 tons, and the total production of oil was 12,480 gallons, equal to 41.5 gallons per ton.

Allowance has been made in this figure for the temperature at which the oil was measured and for its water content, as tested at the Works, and is subject to confirmation after testing the samples of oil taken by me, but it can, I think, be taken as approximately correct.

The oil fuel used, excluding 200 gallons used on the 14th. getting up heats, was 1,040 gallons, which is equal to 3.45 gallons per ton of shale distilled.

The principle on which the retort operates is theoretically sound, but there have been practical difficulties to overcome the nature of which could only be determined through actual experience in the operation of the retort, and there is no doubt, to my mind, that further experience will lead to modifications in design of future units tending to improved operation.

During the test crude oil had to be used as scrubbing oil in the naphtha towers as there is no distillation plant for fractionating the crude oil, and this leads to some loss of efficiency in the production of naphtha.

The production of crude naphtha was 1,097 gallons, equal to 3.65 gallons per ton of shale distilled.

Owing to the manner in which the oils have to be condensed and collected it is impossible to isolate any individual days make, and therefore, the three days when the retort was not working full have had to be included, but on a long run I believe that better results might be expected.

With the installation of a fractional distillation plant which would make the middle fraction available for use in the scrubbing towers, much better results in naphtha recovery could be [illegible] in the towers, and it would, I think, lessen the amount of

(9)

water held in the crude oil as an emulsion.

I have not yet had an opportunity of testing the spent shale , but generally it appeared to be well burnt off.

I understand that it is being sold at £2 per ton for use as a fertiliser, but nobody can say positively, from its chemical composition, why it should so act.

Owing to the nature of the shale a certain amount of dust passes up with the gases into the mains. This is to a large extent eliminated by water sprays at certain points, but, in addition, I would recommend the installation of some form of dust arrester or washer.

I will send in the final report as soon as the tests of the samples have been completed.

Yours Faithfully,

ENGINEER.