GENERAL REVIEW.

OF

OPERATIONS, EXPENDITURE AND RESULTS

AT THE

BRITISH ACETONES TORONTO, LIMITED,

AT

TORONTO, CANADA.

BY

E. METCALFE SHAW, WH.SC., ASSOC. M. INST. C.E.
Engineer-in-Chief.

FEBRUARY 28TH, 1919.

BALANCE SHEET.

Based on Trial Balance November 30th, 1918, with Stocks added as determined to February 28th, 1919.

ASSETS—		
Accounts Receivable		$ 128,833.27
Cash and Bank Deposits		79,657.21
Plant and Equipment, including alterations to Buildings		1,103,178.45
Stores on hand—		
Acetone	$ 41,946.70	
Butyl	1,741,169.43	
M.E.K.	5,553.90	
Supplies	47,222.08	
Corn	299,447.79	
Coal	85,599.20	2,220,939.10
		$3,532,608.03
LIABILITIES—		
I.M.B. Advances	$3,341,315.45	
Accounts Payable	12,405.40	
Drums	22,512.88	3,376,233.73
		$ 156,374.30

PRODUCTION.

PRODUCTION COST. (*No charge for Capital and Directorships*).			
Corn		$2,605,933.72=69.5%	of total cost
Coal		256,653.11= 6.8%	" " "
Factory Expenses	$360,181.52		
Less Stores	47,222.08		
		312,959.44= 8.3%	" " "
Overhead Expenses		47,517.27= 1.3%	" " "
Wages		529,515.11=14.1%	" " "
		$3,752,578.65	
PRODUCTION—			
Acetone		5,744.285 lbs.	
Butyl		11,814,271 lbs.	
			17,558,556 lbs.

Total Production	17,558,556 lbs.
Total Cost	$3,752,578.65
Cost per lb.	21.372 cents.
Cost per ton	$427.44

IS IT POSSIBLE TO RUN THE BRITISH ACETONES, TORONTO, AS A COMMERCIAL PROPOSITION?

NEGLECTING CAPITAL AND MANAGEMENT CHARGES, THE COST OF ACETONE AND BUTYL ALCOHOL DURING THE YEARS 1916, 1917 AND 1918, HAS BEEN 21.372 CENTS PER LB.

This represents the cost during the War period when the prices of materials and labour were exceptionally high. Corn has ranged from 91 cents to $2.39 per bushel (see M.E.K. report September 15th, 1917, the average price being $1.52 per bushel.

Whilst it is certain that the cost of wages and material will not return to the old rates, it is equally certain that they will not be maintained at the War rate.

Now, considering the effect of reduced costs, the most important of these will be in connection with corn, and in view of the fact that it has frequently been as low as 40c. per bushel, it is not unreasonable to assume that after the present shortage has been supplied, a figure of 65c. per bushel may be safely counted on. A reduction, therefore, of the price of corn from $1.25 to 65c. means a reduction of 57.2% of the cost of corn, or taking 100 as the total cost of production, 57.2% of the corn cost of 69.5% equal to 39.75% will be deducted from the total cost.

Coal has cost during the War an average of $6.70 per ton, and a reduction of at least one-third of 6.8% may be counted on in this respect, making say 2.3 again off the total 100 cost.

Factory expenses have been necessarily very high owing to the experimental nature of the whole process in its early stages, and the amount of 8.3 figured on the production cost can be safely reduced by 3.95. Wages are most likely to remain somewhere near their present cost, but it may be expected that increased efficiency and a slight reduction in the price of labour will take 2.1 off the 14.1 due to this item.

PRODUCTION COSTS—WAR COST=100.

	War Cost 1916-1918.	Peace Time Reduction.	Peace Time Cost.
Corn	69.5	39.75	29.75
Coal	6.8	2.3	4.5
Factory Expenses	8.3	3.95	4.35
Overhead Expenses	1.3	0.0	1.3
Wages	14.1	2.1	12.0
	100.0	48.1	51.9

51.9% of the War time production cost of 21.372 cents makes 11.09 cents per lb. as the probable peace time cost per lb. of acetone and butyl alcohol.

Up to this point it has been shown that acetone and butyl alcohol can be produced at a uniform cost of 11.09 cents per lb. and it will be shown further on that an additional cost of $17,000 for catalysers; $3,494 for electric equipment for completing the 36 catalysers; $23,975.47 for completing 54 catalysers with automatic controls, etc.; and $5,000 for completing the acid concentration equipment, making a total cost of $49,469.47 necessary to complete the whole equipment, will put the plant in order for the production of 2,500 tons of acetone and 4,000 tons of methyl ethyl ketone per year.

It seems possible that a market may be found in the United States for about 1,000 tons of butyl alcohol yearly, but unless some new use for this substance is found, no alternative seems possible but to convert 4,000, if not 5,000 tons of it into methyl ethyl ketone.

This substance seems to be as effective as acetone in the production of cordite, and it appears to have some exceptionally good properties as a solvent in connection with high grade varnish. Quite apart from its special value for aeroplane work, the fact that it can be used in the production of very high quality varnish seems to indicate that it ought not to be difficult to find a ready market at a good price.

CONVERSION OF BUTYL ALCOHOL INTO METHYL ETHYL KETONE.

Total yearly Production of Butyl Alcohol, 5,000 tons.

Data obtained during the working of the M.E.K. plant and given in the sectional reports shows that an actual conversion of 75% was made from butyl alcohol into methyl ethyl ketone.

In regular working and with the improvements suggested by experience which were being installed, it is probable that 80% of the 5,000 tons of butyl alcohol or 4,000 tons of methyl ethyl ketone would have been produced.

Conversion of Butyl Alcohol into Methyl Ethyl Ketone.

Labour, 40 men	$60,000.00
Catalyst	35.000.00
Electric Current	48,000.00
Fuel Oil	7,275.00
Steam	10,000.00
Renewals and Repairs	28,000.00
General Expenses	20,000.00
Cost of H_2SO_4	12,000.00
	$220,275.00

This is equal to a cost of 2.75c. per lb. (These figures are based on experience in working the plant).

5 lbs. of butyl alcohol will produce 4 lbs. of methyl ethyl ketone, so that the cost of raw material (butyl alcohol) for producing one lb. of M.E.K. will be 11.09 x 5/4=13.86c. Adding to this 2.75c. (the cost of conversion), the actual first cost of methyl ethyl ketone will be 16.61c. per lb.

Capital, Management and Royalty Charges.

Assuming the business to be capitalised at $2,500,000.00.

Interest, 7½% on $2,500,000.00	$187,500.00
Amortisation 10% on $2,500,000.00	250,000.00
Management 1% on $2,500,000.00	25,000.00
Rates and Taxes, including Business Tax	16,000.00
Insurance	13,920.00
Royalties—½ of 1 cent per lb	65,000.00
Yearly charges	$557,420.00

With an output of 13,000,000 lbs. of solvent, this will add 4.29 cents to the first cost of 11.09 cents and 16.61 cents for Acetone and M.E.K. respectively. This fixes a minimum selling price of 15.38 cents for Acetone and 20.9 cents for M.E.K. per lb.

(1) Is the sudden break from 25½* cents per lb. in the United States to 15** cents due to unloading, or will the latter be a normal price?

*January price New York.
**March price New York.

(2) What is the prospect of the process being worked in the States?

(3) Can a contract be made with the Imperial Government for Acetone and M.E.K.?

(4) What market is there for Acetone and M.E.K.?

(5) Will the special value of M.E.K. for aeroplane and high class varnish find a market for 4,000 tons?

SUMMARY.

Acetone asked for by the Imperial Government in 15 months	250 tons
Acetone actually delivered in 15 months	1,080 tons
Acetone actually delivered to November 30, 1918	2,830 tons
Rate of yearly output November 11, 1919, Acetone	2,500
Estimated yearly output of M.E.K., 1919	4,000
	6,500 tons

(No charge being made for Capital and Directorship.)

Actual cost of producing Acetone and Butyl Alcohol during the War	21.372c. per lb.
Cost of producing Acetone and Butyl Alcohol in future	11.09 c. per lb.
Cost of producing M.E.K. in future	16.61 c. per lb.

Cost in future including Capital and Directorship charges:

Acetone	15.09 c. per lb.
M.E.K.	20.61 c. per lb.

Canada produced 78 per cent. of the Acetone made in the British Empire, of which the British Acetones produced 75 per cent.

Actual Acetone output during the War by the British Acetones, Toronto:

58 PER CENT. OF OUTPUT OF BRITISH EMPIRE.

GENERAL REVIEW OF OPERATIONS, EXPENDITURES AND RESULTS.

The success achieved by the British Acetones Toronto, Limited, has been due to the methods adopted. These may be summarised under the following heads:

(1) MANAGEMENT.

MANAGEMENT—The excellent results obtained at Toronto are evidence on this point. It is perhaps well to emphasize three features of importance:

(1) Almost entire freedom of initiative was allowed to every man holding a responsible post, so long as he worked hard, showed results, and was amenable to suggestion.

(2) The happy combination of capable business control and highly trained specialists.

(3) Realisation that the firing line began right inside the Works.

It should be mentioned that the heads of four departments were graduates of the Toronto University, of which Colonel Gooderham is a Governor. Captain A. E. Gooderham, who was entirely in charge in the absence of the Managing Director, undertook the general management of the Works and offices. J. H. Parkin, B.A.Sc., M.E. Assoc. Mem. Am. Soc. M.E., released from most of his duties as lecturer on Engineering at the University, was in charge of the mechanical department and designed and arranged details as well as general plant layouts. D. J. Thomson, B.A.Sc., demonstrator in Engineering at the University and instructor at the Toronto Technical School, handled the electrical work, and W. Charles Collett, B.A.Sc., took charge of all building operations. The sectional reports written by them testify to their knowledge, ability and thoroughness.

The University of Toronto laid the foundations for much of the success of the British Acetones, Toronto, in training these gentlemen.

(2) METHODS.

These can be classed under four heads:

PROCESS METHODS—*Methods in relation to the processes.*

Whilst very full knowledge of the chemical questions arising in the Weizmann process was supplied by the chemists who were sent out from England, the mechanical arrangements for working the process were changed from the English system of discontinuous to an almost continuous system, and in this matter the very large experience of the writer on similar change of methods in various industries enabled a system of working to be accomplished, which

as characterised by two main features, continuity and a positive tion. These are fully dealt with in the accompanying report.

CONTROL METHODS—*Methods applied to systems of management and control.*

These are fully explained in the reports by the chemists in harge of the operations in their departments. The Fermentation epartment, under the control of Mr. Speakman, offered a particularly good field for systematic working, and a careful investigation ill show this to be a model for work of a similar kind. Another xcellent example of systematic management and record was in nnection with the Electrical Department under Mr. Thomson.

METHODS IN RELATION TO LABOUR—*Methods in connection with e workers.*

Employment of Women—Mrs. Bowes, a lady well qualified for e post of matron, secured the services of a staff of 40 workers, early all of whom were of good social position, and proved to be body of extremely capable and conscientious workers. It was rticularly noticeable that the effect of having refined women in e Fermentation and Distillation Departments tended to elevate e whole tone of the Works.

Men—Wages have been rising (see appended sheet), with e increased cost of living, but the men have earned their oney well. The provision of excellent lavatories, lockers, baths d rest rooms, enabled good men to be secured and retained. our hundred men were regularly employed.

DAY OF REST—*The Day of Rest.*

Colonel Gooderham overruled the wishes of the heads of the partments in regard to a seven-day week, and adopted the six ys of continuous work, closing down everything possible at 12 clock Saturday night till 12 o'clock Sunday night. As time went , the wisdom of this policy was shown, for it enabled all the rkers to remain fresh and keen, and the stopping period was terwards found to be of vital importance as giving an opportunity for thorough cleansing and sterilisation. The record of the t continuous run of 3,480 fermenters dealing with 1,300 tons of sh daily, without the loss of a single fermenter charge, is unestionably due to the good results arising from the Sunday stopge of work.

GENERAL REVIEW OF CONSTRUCTION.

Reference to blue print No. 416, forming part of the Architect's report on Building Operations, will show that the ground area of the premises originally offered by Messrs. Gooderham & Worts, and occupied by the British Acetones, Toronto, Limited, amounted to 31,060 square feet, whilst 178,500 square feet additional ground space was being used by the Company on November 11th, 1918. Thus it will be seen nearly seven times the ground space was being used as that originally offered (see Architect's report).

Complete information on all details of construction and operation will be found in the reports previously presented on July 14th, 1917; September 15th, 1917; February 1st, 1917, and in the four sectional reports accompanying this dated January 31st, 1919.

ACETONE PLANT.

Particulars are given in a sectional report as to the extension of the plant by the provision of further fermenters and the general arrangements made for raising the output from a rate of 1,000 tons, as mentioned in the report of July 14th, 1917, to 2,500 tons per year.

Total expenditure, $407,742.36.

METHYL ETHYL KETONE PLANT.

A large expenditure has been incurred in connection with the Methyl Ethyl Ketone plant, and it was from one point of view unfortunate that it had only just commenced operations when the Works were closed down. The plant was already proving itself a success. Ten tons of rectified M.E.K. had been produced. The reports on the M.E.K. and electrical equipment give complete information on construction and operation.

Total expenditure, $695,436.09.

LETTER HANDED WITH REPORT TO MR. W. NOBLE PIRRIE—The following extracts are from a letter, dated September 26th, 1917, by the writer to Mr. Pirrie, which accompanied the original M.E.K. report:

"Some attention has been given to the construction of a tube

vaporator for the concentration of the sulphuric acid, but this ethod has been rejected for the present owing to the impossibility f getting lead lined steel tubes in reasonable time, and the uncerainty as to the life of the lead lining.

"The tower concentrator, though bulky and costly, is a safe ethod of dealing with this part of the problem and should be instalied.

"The Catalysers are of new construction designed on the lines I ave laid down, as the most efficient means of obtaining as far as ossible, the flow of heat from the metal to the catalyst and then nto the gas. Considerable difficulty has been met with in getting he General Electric Company to quote and undertake the conruction of the Nichrome heating installation. They will take at east 5 months to fill the order, and therefore, if this method of upplying the heat is finally adopted, we may construct the heaters urselves with a saving in time of several months.

"Meanwhile, further attention is being given to a different orm of catalyser heated by oil fuel. An experimental apparatus s being constructed and if successful, the catalyser can be made at reatly reduced cost and in less than three months. If this can be one, it will be possible to reduce the installation period to three nonths, overtime on the lead still and a few other parts will be ecessary, but I should not expect the increase of cost over the stimates to exceed $8,000."

NEW APPARATUS—In this letter a new method of Sulphuric Acid ecovery and two new systems (a) and (b) of catalysing were eferred to, the system (a) being adopted, having been tested on large experimental scale and found to work. The other systems or acid recovery and catalysing have been followed up so far as as consistent with the urgent need for actually getting to work ithout delay with known types of apparatus. Had work conlnued, both had been developed sufficiently to have been in actual se by January 1st, 1919.

NEW CATALYSER SYSTEMS.

CATALYSER SYSTEMS (a) AND (b)—The Catalyser system (a) ow installed (see M.E.K. report), supplied heat partly o the gas and partly to the catalyst. This system is an im-

proved form of the ordinary catalysing tube. All such systems, however, are defective because of the constant danger of polymerisation or decomposition in the hot film on the heat transmitting walls. For this reason the general temperature of the gas has to be kept much below the point of maximum efficiency. Even then it seems probable that the evil effect of the action taking place in the hot film has much to do with poisoning the catalyst, and it was partly for this reason that whilst this system of catalysing was used because at any rate it would give practical results, the second system of catalysing was followed up because it is free of this defect.

Under the second system (b), the fact is utilised that between the high safe limit and lowest effective conversion limit of temperature, there is a margin of probably 78° to 150° F. The gas is heated to the high limit and passed through the catalyst, leaving at the low limit. This action is repeated from four to eight times according to the properties of the gas until conversion is completed. The heating agent is superheated steam, which is never allowed to have a temperature in excess of the high safe limit of temperature of the gas. The gas is heated by the steam in a Shaw Jolt Tube, to within 50° F. or less in some cases of the steam temperature. The real gain by the apparatus cannot be determined except in actual work, but it is safe to state that this system might be expected to provide the operating staff with a far more easily controlled and efficient apparatus than is possible under the (a) system.

The heat is provided by taking steam at say 120 lbs. pressure from the main, passing it through coiled pipes in an oil-heated furnace, when it is superheated to the ascertained safe high limit of temperature, say 900° F., then through a Jolt tube where it supplies heat to the gas, subsequently through another coiled pipe in the furnace where it is further heated, and so on. The plans (which are not complete owing to stoppage), give a good idea of the lay-out—see Drawings A325, A318, A301, A291, B338, B337, B342, C332, C289. The scheme being to pass steam at 120 lbs. through the six sets of heaters and jolt tubes in series, using up say 10 lbs. pressure on each, thus completing the 1st stage catalyser. Then leaving at 60 lbs., the steam passes through another set of interchangers and catalysers for the third stage of say four sets of units, losing 10 lbs. in each again to finally exhaust into a low pressure

system and be available for other steam uses in the Works.

The heating coils are in the second set of flues heated by the gas coming from the first set of flues of the oil furnace, the lower temperature required for the third stage admitting the use of lower temperature heating gases.

The catalysers are arranged five in series and then two in parallel, so that extra time is allowed to complete the reaction in the last stage.

Features of this second catalytic system are:

(1) Reduced cost of plant.
(2) Wrought metal non-porous catalysers.
(3) Exact control of gas temperatures.
(4) Prevention of decomposition and polymerising effect.
(5) Catalysing vessels of any convenient size.
(6) Rapidity of changing catalyst.
(7) Safety-superheated steam is all that can leak into the gases.
(8) A catalyser charged for use is heated by a flow of superheated steam.
(9) General convenience and minimum cost of working.

DETAILS OF EXPENDITURE.

(1) First and Third Stage Catalysers.
(2) Electrical Equipment.
(3) Second Stage, Sulphating Process.
(4) Rectifying Stills.
(5) Acid Recovery.
(6) Miscellaneous.
(7) Buildings.

CATALYSER COST.

COST CATALYSER SYSTEM (a)—Reference to the original report on the M.E.K., dated September 15th, 1917, will show that an estimate was made providing for four 4 ft. catalysers and one 6 ft. costing altogether $6,000. This set was capable of dealing with 50 gallons per hour No. 1 stage; while for the No. 3 stage provision was made for six 6 ft. catalysers, costing $7,200—thus a total cost was allowed for of $13,200 for a 50 gallon plant, $39,600 for a 150 gallon plant, and the cost at this rate would be $66,000 for a 250 gallon plant.

Reference to the M.E.K. report (J. H. Parkin) will show that a total of fifty-four 2 ft. catalysers would have been sufficient to do the work of both first and third stages. From the known lifetime of the catalyst, it is probable that six spare catalysers would have been sufficient to keep the full number in operation. Of the catalysers paid for, about forty would have been found fit for use. Thus twenty more would have been required. If the bronze had still been used, the cost for the remaining catalysers (if purchased from the Delta Company) would have been $17,000. The total cost of the catalysers when operations were stopped was $61,636.17, so that the total would have been raised to $78,636.17 if the plant had been completed.

COST CATALYSER SYSTEM (b)—When work stopped the expenditure on this system amounted to $5,506.53 for catalyser furnaces, piping, etc. The installation would have been finished in about three weeks at a total cost of less than $6,400.00. A complete installation with oil burning furnaces on this system for first and third stages for 250 gallons per hour could have been installed for $35,000.00. This shows a considerable reduction of cost as compared with the (a) system.

ELECTRICAL EQUIPMENT.

The sectional report on the Electric Installation shows that the electrical equipment of thirty-six 24" catalysers for 150 gallon plant with transformers cost $25,678.64 to November 11, 1918, whilst $3,494.00 would be required for completion, making a total of $29,172.64.

The original report (see M.E.K. report September 15, 1917) estimated the electrical equipment necessary for the 150 gallon plant for twenty-one 72" catalysers and twelve 48" catalysers at $103,920.00.

It was found advisable to make shorter catalysers, and by the improved methods of working adopted the total catalyser length has been cut down from 172 ft. to 72 ft. for the same output.

The chief reason for the reduction has, however, been that instead of placing the work in the hands of the General Electric Company, it was left to Mr. D. J. Thomson who designed and installed the whole equipment for this greatly reduced figure. In

addition, his staff of men constructed the heaters and fitted out the whole installation in the most satisfactory manner.

Mr. Thomson's estimate for completing the equipment as a permanent layout with automatic controls is $23,975.47.

The total cost of the electrical equipment for a 250 gallon plant will be $53,148.11.

At the rate of estimate made by the General Electric Company, the cost would have been $173,200 without fixing or wiring.

SECOND STAGE SULPHATING EQUIPMENT.

The report on the proposed M.E.K. plant included the sum of $49,000, being Badger's estimate of the probable cost of the plant needed for carrying out the second stage of the M.E.K. process. After the authorization had been received for the construction of the plant, Badgers raised their estimate to $86,000, stating that they had not been sufficiently informed as to the exact nature of the operation which was necessary, and that they found it absolutely essential that increased provision in some cases and new provisions in others should be made in order to ensure the success of the plant. Bearing in mind the novelty of some of the operations, it is satisfactory to note that the plant as provided answered its purpose completely.

Mr. H. M. Perry closed the contract with Badgers for $72,000, to which amount was subsequently added another $9,000 for further provisions in connection with the scrubbing system. It will thus be seen that the total cost of this part of the equipment was $81,000. Further items which added to the cost of this part of the equipment amounting to $22,406, covering labour, lead, butylene storage tank, and valves, with a further sum of $4,621.43 for various smaller items, raised the total cost of this part of the equipment to $107,621.42, an increase of $58.621.43 over the original estimate.

RECTIFYING STILLS.

It was found necessary to provide two stills not allowed for in the original estimate at a cost of $49,172.00, and the erection of a new Still House with provision for three stills at a cost of $24,549.85.

SULPHURIC ACID RECOVERY PLANT COST.

COST ACID RECOVERY TOWER SYSTEM—The original estimate provided for an expenditure of $60,000 for two 30-ton acid concentrating towers, equal to the demand caused by the 150 gallon plant. Assuming the cost to be pro rata, the 250 gallon plant would have raised the cost for acid recovery plant to $100,000. The costs which have actually been incurred for the sulphuric acid plant are $66,307.87. It must be pointed out that these towers are only capable of dealing with about 60 per cent. of the acid concentration required for the enlarged plant. It will be seen from the M.E.K. report (J. H. Parkin) that the interior passages in towers were showing signs of disintegration, and the use of the Shaw Heat Interchanger system is referred to. It is of interest to note here that in the original M.E.K. report, mention was made of research work on the lines of the writer's "film" evaporators for the concentration of the sulphuric acid, and that this had been put on one side owing to certain difficulties. Reference to this matter is also made elsewhere in the report.

The accompanying report on Heat Interchangers shows how the difficulties have been overcome, and that a practical acid concentrator on these lines has been constructed. The evidence of the tests indicates that this method would have been adopted in connection with the plant, and that the whole of the weak acid could have been concentrated to 50% strength by this means. This would have enabled the towers to deal with the whole of the acid required from the 50% stage, and at the same time would have removed the cause of trouble which was destroying the inside lining. The cost of the interchanger system would not have exceeded $5,000, making the total cost $71,307.87.

MISCELLANEOUS.

This item covers the cost of all the smaller items of the plant, pumps, compressors, tanks, interchangers and labour, including all the work and apparatus of which the need was not foreseen when the original estimates were compiled. In this section $30,817.03 was allowed for the 150 gallon plant. Pro rata this would have been $51,361.72 for the 250 gallon plant, but it actually amounted to $142,113.18.

BUILDINGS AND FOUNDATIONS.

The cost of this section was $109,253.01 instead of $32,423.49 and $54,039.09 for the 150 and 250 gallon plants. This item includes plant foundations, a new still house, transformer house. etc., not previously estimated for.

SUMMARY OF THE M.E.K. PLANT COSTS.

Provision was made in the original M.E.K. report for an expenditure of $315,156.52 on equipment and buildings.

The capacity of the plant installed was raised to 250 gallons per hour, so that not only the new production of Butyl Alcohol could be converted, but that the stock of more than 1,000 tons could be gradually dealt with.

The total expenditure up to November 11th, 1918, was $587,673.93. The completion of the plant would have increased this item by $47,478.00 to $639,099.08.

The enlargement of the plant by 60% would have entailed a total increase in expenditure of 102%.

ACETONE, BUTYL ALCOHOL AND METHYL ETHYL KETONE PLANT COSTS TO NOVEMBER 11TH, 1918.

Total Cost of Plant and Equipment, Alterations to Buildings, etc. and Starting Operations		$1,103,178.45
Equipment, Expenditure on the Fermentation and Distillation Plant for producing Acetone and Butyl Alcohol	$407,742.36	
M.E.K. Costs	695,436.09	
		$1,103,178.45

	Estimate for 150 gallon plant	Pro Rata Cost for 250 gallon plant	Actual Cost to complete plant 250 gal. capacity
Electric Catalysers	$39,000.00	$66,000.00	$78,636.17
Electrical Equipment excluding erection and wiring	103,920.00	173,200.00	53,148.11
Sulphating Equipment Badger contract	49,000.00	81,667.00	107,621.42
Rectifying Stills	.....	.....	24,549.85
Acid Recovery	60,000.00	100,000.00	71,307.87
Miscellaneous — Tanks, Compressors, etc.	30,817.03	51,361.72	142,113.18

BRITISH ACETONES TORONTO, LIMITED

Buildings and Equipment foundation	32,423.49	54,039.09	109,253.01
Total Installation Cost to date			$586,629.61
Estimated Cost of completing the plant			49,469.47
	$315,156.52	$526,267.81	$636,099.08

Butyl Alcohol used on experiments	$96,349.14
Sulphuric Acid used on starting	11,413.02
Cost of starting plant	$107,762.16

SCHEDULE AS TO RATE OF WAGES OF WORKMEN BEFORE AND DURING THE WAR.
TORONTO.

Trades.	June 1914 Hr.	June 1915 Hr.	June 1916 Hr.	June 1917 Hr.	June 1918 Hr.	Nov. 11 1918 Hr.
Steamfitters	45c	50c	50c	50c	65c	65c
Carpenters	45	45	47½	50	60	60
Machinists	40	45	50	55	65	65
Bricklayers	55	55	60	62½	67½	72
Electricians	45	50	50	55	55	67½
Painters	35	35	35	45	50	50
Boilermakers	45	50	50	55	55	55
Coppersmiths	45	60	70	70	80	$1.00
Tinsmiths	40	50	50	60	65	65
Blacksmiths	45	50	50	50	60	60
Labor	30-33		33 1/3-40	40	50	

Firemen $18.00 per week, gradually increased to $27.00, foremen, $28.00
Engineers $20.00 per week, gradually increased to $33.00, foremen, $40.00

E. METCALFE SHAW,
Engineer-in-Chief.