February 12, 1925.

TO: EXECUTIVE COMMITTEE

FROM: CHEMICAL DEPARTMENT - DIRECTOR

In accordance with your suggestion recently passed on to me "that the Chemical Department be advised that the Executive Committee would like to have an annual report from them along the lines indicated in the third paragraph" of the Chemical Department's transmitting letter of March 10th "but in much more condensed form", I am attaching hereto a brief report of the activities of the Chemical Department during the year 1924. I have omitted from this report, in so far as possible, chemical terminology, with a view to making the report more readable without any sacrifice in clarity.

An effort has been made to show the monetary returns resulting from the work, where it has been possible to make some sort of an estimate of these returns, but in numerous cases such an estimate is impossible. For example, how shall we set a figure on the value of an important ingredient of Duco? Such ingredients have been synthesized by the Chemical Department, but it may be argued that if the Chemical Department had not found these materials, some other materials might have been found which would serve the same purpose. Such an argument does not alter the fact that in many cases the work of the Chemical Department has resulted in important contributions to the list of the Company's products, but such contributions have taken the direction of alterations of existing formulae or the discovery of products, or processes for producing products, which are essential ingredients in the finished articles offered for sale. I have in mind particularly results obtained in connection with finishes of various types.

It should be pointed out that the classification of some of these pieces of work, such, for example, as the activities of the Chemical Department in connection with the Sulphuric Acid Committee; or those involving general sulphuric acid studies; or vise and audit work; or chemical control work, do not fall entirely under any one of the headings, "Direct Savings", "Indirect Savings", or "Quality Improvement", since the results of the work sometimes bring about improvement in quality and again result in indirect savings. In fact, at times the work results in very direct savings, as, for example, the improvement of the purification train in our sulphuric acid plants, with a view to decreasing the number of regenerations of our contact mass which may be necessary, as well as with a view to improving the general average conversion. These are exactly the results which have been aimed at in connection with some of our sulphuric acid work during 1924, and there is every prospect that success will be realized.

I am by no means insensible of the fact that by far the larger proportion of the work carried out by the central Chemical Department for the various industrial departments, not only along consulting lines but along research lines as well, has not resulted in striking advances in the art nor has it led to the development a product or process likely to yield a net profit of hundreds of

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thousands of dollars a year. It has often been argued that the central Chemical Department ought to devote a great deal of attention to the development of radically new things, and it has been suggested that it is perhaps a mistake to have this department do so much work of the present nature. It should be borne in mind, however, that pretty complete familiarity with the processes and products of an industrial line is necessary in order that intelligent and really productive consideration may be given to questions involving radical improvements or departures from the products comprised in the present lines of industry. I do not believe that it would be possible for a central Chemical Department to produce the desired results if the department were actually divorced from the great mass of work which it now carries out for the various industrial departments, set off to one side and, in a manner of speaking, directed to "invent some good, big, profitable things". The intimate touch with the various industrial lines of the Company is, to my mind, absolutely indispensable for your central Chemical Department. On the other hand, I recognize that we are, just now, so completely tied up with work for the various departments, that there is available neither personnel nor time to undertake work along any very radically new lines. I plan, as conditions make it possible, to provide the necessary slack in the department to enable the department to give consideration to some radically new things, i.e., new so far as the Company's present manufacturing lines are concerned. In order to do this economically, however, it must be done carefully, and, especially, the men delegated to the work must be carefully selected. I have in mind attention to such problems as synthetic resins to serve as substitutes for Pyralin window sheeting. I cite this particular example because I wish to make another point in this connection. Should work of this nature be successful, (either within the duPont Company or outside of the Company), immediate consideration of the effect upon Arlington's business is involved. It, therefore, seems logical at the same time to give considerable attention to the question of so altering Arlington's products that wider fields of usefulness may be found for them because of improved properties, and yet confining the alterations to such developments as may not preclude continuation of the manufacture in the present equipment. It should be recognized that the question of the development of any new process or product has many angles.

I should like to add that when one of our research staff is called upon to develop something radically new, we do not hedge him about and weigh him down with the consideration of all the various angles of the problem. Otherwise, he might never get forward with the work. It is desirable, however, that within the department the necessary perspective be available.

In an attempt to clarify this question of the value in dollars and cents of the Chemical Department's work, I have classified all the subjects to which we gave any considerable attention during 1924 on the following basis:- Group 1 - Work undertaken with prospects of direct savings; research work wholly or practically complete. Group 2 - As group 1, except research work is incomplete. Group 3 - Indirect savings, not estimated in dollars and cents. This group includes also new processes involving potential profits rather than savings. Group 4 - Investigations aimed at improvement in quality.

A brief and rather sketchy summary of the work of the central Chemical Department during 1924 follows, arranged in accordance with the foregoing captions.

GROUP 1

Alum Manufacture
Congo Ester Manufacture
High Silica Barytes as
 Source of Black Ash
Liquid $SO_2$ Manufacture
Solvent Recovery - Newburgh
Solvent Recovery - Tetra Ethyl Lead
Strontium Nitrate Process Revision
Study of Paulsboro as separate unit
Zinc Liquor Purification
White Lead - Continuous Reel

GROUP 2

Alumina Hydrate Manufacture
Base Varnish
Dry Colors (Yellows)
Ester Gum
Oxidation of Ammonia

Group 3

Cryptox
Core Oil
Butyl Alcohol
Southern Electro-Chemical
 Company's Suit
Glycerine by Fermentation
Lithopone Patent Situation
Pratt Process
Sodium Cyanide
Slow-burning Pyroxylin Plastics
Synthetic Ammonia
Sulphuric Acid Committee
General Sulphuric Acid Studies
Calvert Process
Tribromanilin

GROUP 4

Basic Alum
Basic Oil Study
Ethyl Cellulose
Gold Seal Lithopone Improvement
Flintflex
Green Seal Lithopone
Deterioration of Fabrikoid
Improvement of Automobile Finish
Premier Mill
Softeners for Pyroxylin
Rubber Top Varnish
Spar Varnish
Nitrocellulose in Varnishes
New Explosives
Visé and Audit Work

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It has been our habit, year by year, to point out that in those cases where an effort has been made to estimate the actual value of the work of the Chemical Department in terms of dollars saved or earned, the central Chemical Department disclaims any desire to claim all the credit for these savings. It must be perfectly obvious that the results that have been obtained are realized only through the joint effort and complete cooperation of all the interested departments. Certainly the reduction to manufacturing practice by the interested industrial department is as essential as the suggestion of the idea and the preliminary laboratory and semi-works development which may be carried out in the Chemical Department.

GROUP 1

Alum Manufacture:-

1924 Expenditure - $3,540.84. Savings - $14,000 per annum.

Congo Ester Manufacture:-

1924 Expenditure - $8,048.83. Indicated possible yearly saving as result of this work now complete - $19,000. See Exhibit No.

High Silica Barytes as Source of Black Ash:-

1924 Expenditure - $3,801.60. Probable savings, total of Newark and Philadelphia possibilities - $88,000 per annum. See Exhibit No. 2.

Liquid $SO_2$ Manufacture:-

1924 Expenditure - $844.56. This plant continued to be operated throughout 1924, having a total production of 702,000 lbs. Production in 1923 was 466,500 lbs., making a total production from February 1923 to date of 1,168,500 lbs. During this same period there was purchased outside 840,000 lbs. at an average price, delivered, of 4.91¢ per lb. When the sulphur dioxide plant was first built, the Company was paying 6.10¢ per lb., delivered. It seems reasonable to conclude that the average price was lower over the period of the operation of the plant due to the fact that our suppliers knew well of the existence of our plant and that we would not stand for exorbitant prices. This is borne out by the tendency of the price of purchased gas to fall still lower. Savings (last three months of 1924 only are included) - $10,605 total. See Exhibit No. 3.

Solvent Recovery - Newburgh:-

1924 Expenditure - $853.47. Savings - $100,000 per annum. See Exhibit No. 4.

Solvent Recovery - Tetra Ethyl Lead:-

1924 Expenditure - $3,376.58. (Recovery system put into operation in November or December, 1924.) Savings indicated - $300 to $500 per day. It should be added that the measurement of ethyl bromide losses indicates the escape of a quantity equivalent to more than $1,000 a day. Only partial recovery possible. Per annum saving may be anywhere between $75,000 and $100,000.

Strontium Nitrate - Process Revision:-

1924 Expenditure - $2,780.51. Indicated savings - $18,000 to $80,000 per annum. See Exhibit No. 5.

Study of Paulsboro as Separate Unit:-

1924 Expenditure - $1,186.37. Visé and audit work was concerned with the economics of chamber sulphuric manufacture at Paulsboro, and incidentally involved a study of the manufacture of strontium nitrate and hydrochloric acid at Paulsboro. While most of the recommendations involved were tabled for further investigation, I am informed that, as a result of this investigation, Paulsboro was made a sub-division of the Philadelphia Works, which Mr. Denesh tells me is saving them $3,000 per month, or $36,000 per year.

Zinc Liquor Purification:-

1924 Expenditure - $3,520.41. Indicated savings (zinc at .095¢ per pound) $49,000 per annum. See Exhibit No. 6.

White Lead - Continuous Reel:-

1924 Expenditure - $5,612.15. Indicated savings - 35% on investment of $130,000. Value in connection with negotiations with

National Lead Company certain but indeterminate. See Exhibit No. 7.

## GROUP 3

Alumina Hydrate Manufacture:-

1934 Expenditure - $2,501.64. Study made of manufacture of color makers' alumina hydrate successful in determining factors essential to production of transparent product, and must result in very considerable improvement in manufacturing process. Too early to estimate amount.

Base Varnish:-

1934 Expenditure - $3,462.62. Goal of study; replacement of duPont Company's varnish formulae, 5,000 in number, by about 25 formulae. Result; reduction of stock, use of larger manufacturing units (varnish kettles), greater ease of control, improvement in quality of finished product, correlation of work of the different plants.

Value of work; Certain but indeterminate in amount until we have results on reduction of stocks.

Dry Colors (Yellows):-

1934 Expenditure - $10,020.44. Possible yearly savings indicated - $78,690. See Exhibit No. 11.

Ester Gum:-

1934 Expenditure - $1,074.94. A laboratory study has been made demonstrating the possibility of producing our own ester gum from glycerine and rosin. The study was so conducted as to show the best conditions for production from the point of view of cheapness and ease of operation as well as quality of product. As a result, the process is now ready for semi-plant scale development. The investigation showed the possibility of a considerable saving in cost coupled with an increase in quality. Indicated savings are the difference between the market price, which is about 10¢ per pound, and our cost of manufacture, which will be 7-8¢ per pound, multiplied by the number of pounds which it may be found possible to use. Ester gum consumption figures for four duPont varnish plants for first half of 1934 were 61,265 pounds. On the basis of 122,500 pounds a year, our saving would, therefore, be $3600 a year. See Exhibit #8.

Oxidation of Ammonia:-

1934 Expenditure - $10,860.03. Savings;- in connection with small unit installed at Philadelphia for production of oxides of nitrogen for the chamber process; also, single unit plant just started at Repauno, capacity 5,000 lbs. 100% $HNO_3$ per day (delivered as 50% acid, however) at a saving of close to 1/3¢ a pound; also, extension of process for oxidation of ammonia to produce nitric acid to take care of Company's general requirements; also, development of improved equipment for resistance to dilute $HNO_3$. The foregoing results are tangible enough, but can scarcely be assigned a monetary value at this time. See Exhibit No. 9.

## GROUP 3

Cryptox:-

1924 Expenditure - $3,407.09. This pigment can be made in Gold Seal lithopone equipment. It can be regarded as a modified Gold Seal lithopone, owing its increased hiding power to a considerable increase in its zinc sulphide content. Single small lot made on semi-works scale gave satisfactory results as to color and strength. Because of potential competition of Titanox, the product is very interesting. If successful in putting it across, will be fine money-maker. See Exhibit No. 10.

Core Oil:-

1924 Expenditure - $3,069.47. Work successful in developing about 50 raw material combinations from 200 raw materials available, any one of the 50 being more efficient than linseed oil which is used at present. Ultimate value of work depends upon amount of product manufactured, and quality of material selected to market.

Butyl Alcohol:-

1924 Expenditure - $12,741.46. Work on this subject ceased in June, upon completion of satisfactory arrangements with Commercial Solvents Corporation. Expenditures were mostly in connection with patent situation, and this information was useful in connection with negotiation of contract with Commercial Solvents. Some experimental work was carried out on our process for making butyl alcohol and acetone from molasses. Commercial Solvents' process involves corn as raw material.

Southern Electro-Chemical Company's Suit:-

1924 Expenditure - $1,284.85. Much time spent in assisting lawyers in connection with Duke Suit. Repauno experimental tower altered and very useful results obtained in connection with actual demonstration of process. Our lawyers' brief in this case thoroughly reviewed, certain inconsistencies removed, and certain points emphasized which had not, perhaps, been sufficiently brought out. Monetary value of Chemical Department's work on this matter I believe to be very large. It should be borne in mind that, naturally enough, both the lawyers and the experts whom we employed were completely ignorant of the technical details involved and had to be educated. Much work done by us in this connection. Also much excellent testimony for our side of the case obtained as result of our work.

Glycerine by Fermentation:-

1924 Expenditure - $30,813.30. Eight large runs were made at Peoria. These runs were all made with the same lot of molasses. The yields were lower than average and below what we had expected. It was further demonstrated that the expected recoveries of glycerine from the spray tower were not obtained even when a weighed amount of pure diluted glycerine was put through the spray tower. Indications that changes in design or material of construction in spray tower would be necessary. Further experimental work in the laboratory carried on in latter part of year. Reasons for spray tower decompositions probably located. Seems likely that spray tower yields can be much improved by certain changes. Improvement of yields obtained from molasses, normally giving low glycerine, still problematical. However, the process might be profitable on basis of improved spray tower yields if we obtained only the average yield of glycerine and of alcohol which our full works scale runs have shown to date.

Lithopone Patent Situation:-

1924 Expenditure - $5,182.59. Proposed methods of defense against threatened suit by New Jersey Zinc Company have been devised and tested, and much data has been obtained bearing on the validity of the claims of the New Jersey Zinc patents. Prior art samples of great potential value have been uncovered, and their authenticity established. A number of statements made in New Jersey Zinc Company's patents have been checked experimentally. As a whole, I am well satisfied with the results of the work, but it seems to me little can be said about the indirect savings. We are expecting to be involved in an infringement suit, and we are taking active steps to prepare ourselves for defense. Certainly, if we are successful, the savings will be large.

Pratt Process:-

1924 Expenditure - $2,283.53. The expenditures in question were not concerned solely with an investigation of the Pratt process, but were also concerned with an attempt to apply water dispersions of rubber at Fairfield in connection with themanufacture of rubber automobile top material. Mr. Pratt gave his personal assistance in some of these experiments. The experiments were discontinued because they gave little promise of definite savings at that time. At present there is no immediate prospect of water dispersions of rubber proving useful in connection with the Company's products.

Sodium Cyanide:-

1924 Expenditure - $2,879.00. By far the greater portion of this expenditure was in connection with the determination of the value of the by-product carbon produced from our cyanide process. It was indicated that this by-product would probably be quite valuable.

The process was published and elicited exceedingly favorable comment in the technical journals, both in the United States and England. The general tenor of the comments was to the effect that the process reflected great credit upon the ingenuity and resourcefulness of the duPont Company.

Slow-Burning Pyroxylin Plastics:-

1924 Expenditure - $1,612.40. Radio panel material affords profitable outlet for Pyralin. Non-Flam formula - tricresyl phosphate and gypsum combination - covered by patent owned by Celluloid Company. We have developed for Arlington satisfactory alternate formulae. Have also furnished Legal Department information in connection with patent validity investigation. Work indispensable and known to be of considerable value.

Synthetic Ammonia:-

1924 Expenditure - $16,387.03. Prior to formation of Lazote, Incorporated, experimental work was carried on at the Station on hydrogen production, as well as patent studies and cost studies, and certain experimental work on details connected with Claude process. Beginning with September, results of work covered directly by Lazote reports and Experimental Station personnel transferred to Lazote. This work is indispensable in connection with the development of the manufacture of synthetic ammonia.

Sulphuric Acid Committee:-

Expenditures in this connection not definitely segregated. Part of one man's time. Much valuable work accomplished in coordinating information and experience on contact sulphuric acid manufacture among various departments of the duPont Company, as well as in applying valuable information obtained from visits to outside plants. Result: Improvement in design and operation of duPont plants. Considerable improvements are being realized in this connection.

General Sulphuric Acid Studies:-

Expenditures in this connection not segregated. Part of two men's time. Result: Changes in design and arrangement of Company's sulphuric acid plants at Barksdale, duPont, Louviers, and suggestions in connection with the plant of the South American Explosives Company. Cooperated with Engineering Department in connection with design of contact plant for the Tennessee Copper Company and for the Pennsylvania Salt Company. Small amount of fundamental work done in laboratory. Perfectly definite results obtained of undoubted value.

Calvert Process:-

1924 Expenditure - $958.88. Investigation (for the Development Department) of an English process dealing with manufacture of alcohols from carbon monoxide and hydrogen, and a second process for manufacture of molded rubber articles by incorporation of natural rubber latex with fillers and vulcanizing agents. Demonstration of the alcohol process disappointingly inconclusive. Rubber process not sufficiently attractive to warrant our further interest.

Tribromanilin:-

1924 Expenditure -$1,697.63. Chemical Department asked to obtain certain chemical information in connection with a process suggested by the Ethyl Gas Corporation for which duPont Engineering Department has been asked to build a plant. Object:- To relieve bromine shortage by recovering bromine from sea water as tribromanilin. Yields obtained in the laboratory roughly equivalent to between 0.85 and 1.0 pound of tribromanilin from 1800 gallons of sea water. Many elements of uncertainty involved.

GROUP 4

Basic Alum:-

1924 Expenditure - $995.86. Object:-Production of basic aluminum sulphate superior to ordinary aluminum sulphate for water purification. Patent application prepared; product can be manufactured at lower cost than ordinary alum. At present this Company sells about 12,000,000 pounds of alum per year for water purification purposes at an average price of $1.30 per hundred pounds.

Basic Oil Study:-

1924 Expenditure - $2,093.30. Objects:- (1) Development of oil intermediates which can be combined with varnish gum intermediates (to be developed in connection with another study) to produce finished varnish formulae; and (2) the standardization of methods of oil treatment. An ideal paint oil will be one which combines properties of quick drying, maximum hardness and great durability.

Ethyl Cellulose:-

1924 Expenditure - $8,598.53. Object:- The development of the possibilities of ethyl cellulose as a film-forming material for Non-Flam film. Ethyl cellulose also of interest because of possibilities of usefulness in artificial silk, Duco, Pyralin substitute, and insulating material. Basic patents to Lilienfeld in hands of Chemical Foundation. Exclusive license for use of material in photographic film owned by Eastman Kodak Co., who have also taken out a number of other patents on cellulose ethers. Patent situation is being investigated. Much valuable experimental information obtained. Because of the attractive properties of this cellulose derivative, the investigation is being continued, in spite of the rather complicated patent situation.

Gold Seal Lithopone Improvement:-

1924 Expenditure - $19,959.69. Attention devoted both to method of manufacture as carried on at Newark and to improvement of properties of finished pigment. Tangible results obtained:-

Large saving in zinc consumption; better standardization of process of manufacture; improved texture; improved paint grinding properties. By-product of investigation:- Application of methods for improving paint-mixing properties of lithopone to general improvement of paint-mixing properties of all our pigments. Results in this connection perfectly definite and quite promising.

Flintflex:-

1924 Expenditure - $49,795.18. Object:- To develop a baking automobile finish of improved durability. Result:- As a flexible, tough, very durable finish for automobiles, exhibiting superior anchorage to metal panels, Flintflex appeared to be a very promising development, but the popularity of air-drying spraying Duco led to discontinuance of the work so far as the use of Flintflex as a top coat material is concerned. Instead, the unique properties of Flintflex are now the object of study in connection with the development of improved undercoating materials to be used with Duco.

Flintflex also under investigation as an insulating varnish, as well as an ingredient of formulae containing nitrocellulose.

Green Seal Lithopone:-

1924 Expenditure - $4,450.95. In March we were requested by the Paint Department to undertake a very considerable improvement in the quality of Green Seal lithopone, to be effected without important changes in the existing equipment, the quality goal being very definitely set up by the Sales Division. The first plant run indicated definitely that the desired quality could be obtained in the Green Seal equipment, and runs made in August produced a large amount of pigment equal to goal quality in every respect. Change in sales policy deferred further development. Late in 1924, however, the plant undertook further development, involving application of the results we had obtained.

Deterioration of Fabrikoid:-

1924 Expenditure - $7,474.36. In this field we have done pioneer work and obtained positive and valuable results. We have discovered groups of substances which, when added in small amounts to the ingredients of the Fabrikoid film, inhibit the oxidation of the vegetable oils used as softeners, retard the development of rancidity and the deterioration of the film. We expect to obtain valuable patents on these discoveries; one preservative is now used by Newburg in all dark-colored goods except black, and another in all light-colored goods including white. Black goods have never been as bad a white and colored goods. It is safe to say that our Fabrikoid is no practically free from rancidity, and that the keeping quality of all colored goods has been very greatly improved. Improvement is especia noticeable in brown goods, once the worst offender. You will be interested in the fact that an arrangement has been made with Nobels to use our preservatives on a royalty basis.

Premier Mill:-

1924 Expenditure - $668.78. This so-called "colloid mill", manufactured in England and designed for very fine disintegration and formation of emulsions, has been investigated by us, both as to its adaptability to the dye business and the paint, varnish and lacquer business. Tangible and valuable results have been obtained in connection with its use for a particular line of dyes, as well as in lithopone grinding.

Softeners for Pyroxylin:-

1924 Expenditure - $3,003.83. We have carried out pioneer work during the past several years on solvent softeners for pyroxylin. Definite and valuable results have been obtained. Dibutyl phthalate, an important ingredient of Duco, is one of the developments. I believe it is safe to say that Duco cannot be satisfactorily manufactured without solvent softeners, and our study of this field has been most useful to the company, and has given it a considerable advantage in developing a superior product. Another softener which we have developed is acetyl laurin, regularly used at Newburgh as a small percentage ingredient of certain jellies. Certain new softeners have been developed during the year, such as glycol tolyl ether laurate, which is one of the most interesting, and several thousand pounds of synthetic, high-boiling softeners have been manufactured at the Station for use in plant experiments at Newburgh and Parlin.

Rubber Top Varnish:-

1924 Expenditure - $705.83. The problem of a durable finishing varnish for use over rubber automobile top material is of first importance in connection with the business of Fairfield. The trend to closed cars has made inroads in the use of the material ordinarily used for open-car tops, necessitating attention to the development of a type of finish for the closed-car top which shall be very durable and retain the necessary gloss. This work was begun December first, and no conclusions can be drawn as to the probability of successful results.

Spar Varnish:-

1924 Expenditure - $3,290.67. Object:- The development of a spar varnish as good as the best of our competitors' products. Result:- The best competitive products have been equalled in all properties except gloss, and considerably greater durability has been obtained. Results have been turned over to the plant for application and the chemist trained in the work transferred to the plant.

Improvement of Automobile Finish:-

1924 Expenditure - $10,535.89. This work, undertaken originally to improve Flint's paint and varnish lines for auto finish, chiefly by the formulation of long oil baking enamels of great durability, led to much valuable information. For example, the devel ment of a method of processing Chinawood oil, the design and study o accelerated weathering test for paint and varnish panels, information as to the effect of certain driers and pigments on the rate of curing or drying of finishes, as well as upon durability, the effect of certain fossil resins on the physical properties of the finish in which they are incorporated, and other indispensable information of a similar character.

Nitrocellulose in Varnishes:-

1934 Expenditure - $5,321.54. Definite results have been obtained from the investigation of methods for incorporating nitrocellulose and ethyl cellulose in varnishes. The results obtained in connection with nitrocellulose are particularly interesting and are believed to be of great value.

New Explosives:-

1924 Expenditure - $7,988.98. About $4,500 of these expenditures are directly chargeable to our work on the development of new ingredients for flashless, non-hygroscopic, smokeless powder. Very tangible and interesting results have been obtained. New products have been devised which appear adapted to the purposes in mind. Patents have been applied for. It is possible that some new stabilizing agents may also result from this study.

Visé and Audit Work:-

1924 Expenditure - $14,736.16. The work comprised under this heading has been concerned with such matters as contact sulphuric acid, chamber sulphuric acid, acetic acid manufacture, hydrochloric acid manufacture, strontium nitrate, and various other studies. Reference has already been made to some of the tangible results of this work. An inspection of the Arlington plant was made late in the year. There is also some general consulting work, such as some attention which we have been giving to the Fibersilk and Cellophane operations, which has been taken care of under this heading - Visé and Audit. Certain studies in connection with the recovery of spent acid and with methods of yield accounting and operation, particularly in sulphuric acid manufacture, have been paid for out of this account.

The total amount of money spent by the Chemical Department during the year 1924 was $360,851.83. Of this amount the expenditure of $33,545.32 shows an indicated saving of $434,350 per annum on Group 1 work alone. It should further be pointed out in this connection that while some of the savings indicated are not yet in force, like the continuous lead reel process, others which are in force indicate much larger returns during 1925 than the figures cited for 1924, because the 1924 figure covers only a few months' operation. The liquid $SO_2$ process is a notable example in this connection, where the figure cited is $10,805, but the indicated 1925 saving is $33,250. On the other hand, it should be pointed out that the expenditures by the Chemical Department on such things as the continuous reel process do not give the whole story, because the Engineering Department has also been spending money on experimental work in this connection. Actually the only complete picture would be a complete report on the total expenditures involved, upon the completion of a given piece of work and the actual operation of a plant for a few years, together with the plant investment involved and the profits or savings realized. Obviously our figures for savings realized, or expected, and research expenditures, must only be taken as an indication of the value of the work of the Chemical Department and not as a profit and loss sheet.

The total of the individual accounts cited in this report is $283,181.54. This figure takes no account of expenditures by the Chemical Department for a number of individual departments where the expenditures were made at the direct request of the department and the cost of the work was billed out directly to the interested department. For example, there was $1,089 worth of analytical work on nitrate of soda for the Purchasing Department; $3,640 worth of work for the Engineering Department; $2,889 for Cellulose Products Department; $1,851 for Explosives Department; $2,335 for Paint Department; Dyestuffs Department, $1,753; $9,175 of miscellaneous products; $15,574 for Lazote; $1,352 billed against Grasselli for lithopone patent situation investigation; general work for company not chargeable against a specific industrial department, $19,848; and many small pieces of work costing two or three hundred dollars apiece. These go to make up the $75,000 difference between the total expenditures of the Chemical Department for 1924 and the expenditures itemized in this report. It is probably not worth while to go into the details of these expenditures in a report of this nature where so much interesting and essential information in connection with the most important research work has already been omitted.

Continually increasing amounts of work have been requested by the industrial departments, though the individual totals have fluctuated. I believe it is fair to say that the past year has marked a further advance in the efficiency of the Department. It will be obvious from this report that the work which has been carried out has been very concrete and very definitely aimed at results of value to the Company.

CHAS. M. A. STINE,
CHEMICAL DIRECTOR.

CMAS;E-11*

EXHIBIT NO. 1.

CONGO ESTER - POSSIBLE SAVINGS.

(Expended 1924, - $8,048.83).

Consumption of Kauri Gum at Varnish Plants during first 6 months of 1924:

| Plant | lb. price | Quantity | | Value | |
|---|---|---|---|---|---|
| Chicago | 18¢ | 3900 | | 703. | |
| | 60¢ | 17000 | 20900 | 10200. | 10903. |
| Philadelphia | 26-1/2¢ | 7000 | | 1855. | |
| | 10¢ | 1450 | | 145. | |
| | 42¢ | 800 | 9250 | 336. | 2336. |
| Everett | 42¢ | 1800 | | 756. | |
| | 18¢ | 150 | | 27. | |
| | 10¢ | 350 | | 35. | |
| | 26-1/2¢ | 2700 | 5000 | 715. | 1533. |
| Total, all plants, for six months, | | | 35150 | | 14771. |
| Yearly consumption on six months basis | | | 70300 | | 29542. |
| Congo Ester | 15¢ | | 70300 | | 10545. |
| Possible yearly saving by use of Congo Ester, approximately | | | | | 19000. |

Work with this problem prior to January, 1924 established some of the fundamentals of the process. A number of the difficulties of preparing Congo Ester in small, open-kettle batches, together with the best means of meeting these difficulties, had been fairly well worked out. More than half of the year was therefore spent at the different plants introducing Congo Ester and further standardizing the method of its manufacture.

This work very clearly established the value of Congo Ester as a varnish gum. In quality it was found to be unsurpassed, even by the much more expensive resins, especially in regard to durability and water resistance. Likewise, when properly prepared, it gives a very hard varnish, being in this respect practically the same as the very expensive Kauri. Congo Ester can be used as an intermediate, like rosin or ester gum, and hence Congo Ester varnishes are very easy to prepare as compared with Kauri, Manila, Pontianac, etc. The color of the Congo Ester varnish is much superior to a similar hard gum varnish, which in turn will cost considerably more than the esterified Congo. These varnishes are, of course, practically neutral, and hence can be used with basic pigments without danger of livering.

The cost of Congo Ester will vary with the hardness, acid number and color desired, but two very good grades can probably be prepared at approximately ten and fifteen cents per pound, respectively, as compared with Kauri of thirty-five and sixty cents.

EXHIBIT NO. 1.

CONGO ESTER - POSSIBLE SAVINGS.

(Expended 1924, - $8,048.83).

Consumption of Kauri Gum at Varnish
Plants during first 6 months of 1924:

| Plant | lb. price | Quantity | | Value | |
|---|---|---|---|---|---|
| Chicago | 18¢ | 3900 | | 702. | |
| | 60¢ | 17000 | 20900 | 10200. | 10902. |
| Philadelphia | 26-1/2¢ | 7000 | | 1855. | |
| | 10¢ | 1450 | | 145. | |
| | 42¢ | 800 | 9250 | 336. | 2336. |
| Everett | 42¢ | 1800 | | 756. | |
| | 18¢ | 150 | | 27. | |
| | 10¢ | 350 | | 35. | |
| | 26-1/2¢ | 2700 | 5000 | 715. | 1533. |
| Total, all plants, for six months, | | | 35150 | | 14771. |
| Yearly consumption on six months basis | | | 70300 | | 29542. |
| Congo Ester | 15¢ | | 70300 | | 10545. |
| Possible yearly saving by use of Congo Ester, approximately | | | | | 19000. |

Work with this problem prior to January, 1924 established some of the fundamentals of the process. A number of the difficulties of preparing Congo Ester in small, open-kettle batches, together with the best means of meeting these difficulties, had been fairly well worked out. More than half of the year was therefore spent at the different plants introducing Congo Ester and further standardizing the method of its manufacture.

This work very clearly established the value of Congo Ester as a varnish gum. In quality it was found to be unsurpassed, even by the much more expensive resins, especially in regard to durability and water resistance. Likewise, when properly prepared, it gives a very hard varnish, being in this respect practically the same as the very expensive Kauri. Congo Ester can be used as an intermediate, like rosin or ester gum, and hence Congo Ester varnishes are very easy to prepare as compared with Kauri, Manila, Pontianac, etc. The color of the Congo Ester varnish is much superior to a similar hard gum varnish, which in turn will cost considerably more than the esterified Congo. These varnishes are, of course, practically neutral, and hence can be used with basic pigments without danger of livering.

The cost of Congo Ester will vary with the hardness, acid number and color desired, but two very good grades can probably be prepared at approximately ten and fifteen cents per pound, respectively, as compared with Kauri of thirty-five and sixty cents.

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| Yearly consumption on six months basis | | | 70300 | | 29542. |
| Congo Ester | 15¢ | | 70300 | | 10545. |
| Possible yearly saving by use of Congo Ester, approximately | | | | | 19000. |

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The cost of Congo Ester will vary with the hardness, acid number and color desired, but two very good grades can probably be prepared at approximately ten and fifteen cents per pound, respectively, as compared with Kauri of thirty-five and sixty cents.

DUP150089421

EXHIBIT NO.2.

HIGH SILICA BARYTES - PROBABLE SAVINGS

Expended 1924 - $ 3,801.80

Reduction of High Silica Barytes

It is generally recognized that silica is a very detrimental impurity in barytes and its presence in excess of 4% is undesirable in the ore used for the production of barium sulphide. As a result, only the better grade of ore is being mined which, coupled with the fact that it undergoes a purification treatment, makes its cost appreciable, while there is also the possibility of an increasing demand overtaxing the supply. At the same time there are large deposits of barytes containing from 10 to 15% silica which are unfit for this purpose at present and can be obtained at a much cheaper price than the present ore. The utilization of such ore is the object of this study. Our attention is particularly directed toward a large deposit in South Carolina containing approximately 1,000,000 tons owned by the Product Sales Corporation.

Our rather thorough study of the black ash furnacing operation in the plant, made several years ago, which set up standards for operation and yields that are at present used, had shown that one pound of silica rendered unavailable 2.7 lbs. barium sulphate. Consequently, this high silica ore would give a yield of water-soluble barium sulphide of approximately 60% in plant operation as compared with an average of 80% for an average grade of ore used by the plants and it is therefore uneconomical.

Our laboratory work using a briquetted charge, made 1-1/2 years ago had shown that this method cut down the deleterious silica reaction to a great extent. This knowledge applied to high silica ore in the present work resulted in the same inhibition of the silica action and the obtainment of a conversion of 90% to water-soluble barium sulphide. Following this a considerable amount of laboratory work successfully solved several problems in connection with these briquets, such as hardness, binder, nature of coal, fineness of materials, temperature of furnacing, and leaching of resultant black ash. Plant tests consisting of five runs, based upon laboratory experience, showed that briquets made from ore containing 85% $BaSO_4$ and 14% $SiO_2$ gave successful operation in the present rotary furnace and particularly that a conversion of 90% can be obtained in the plant. This yield is comparable with 60% which would have been obtained with this ore in the ordinary practice and with 80 to 83% obtained with present ore containing 92 to 95% $BaSO_4$ and 4 to 2.8% $SiO_2$. Due to this high conversion, the weight of barium sulphide from one ton of ore is the same as with present high grade ore. Another favorable result was the absence of sticking of the charge to the furnace walls which, besides eliminating the barring required at present, would make possible the operation of a continuous kiln for this purpose since the sticking constitutes a serious obstacle in this connection.

The use of briquets applied to low grade and high silica ore will consequently result in a considerable saving. As listed below, this consists of several items, chief of which is the difference in the cost of ore. The present cost is $8.00 (1/25/25) per ton plus $8.00 freight, while assurance of a price of $5.50 per ton for the low grade ore has been obtained and there is a possibility of a price of $4.50 per ton. There is also a cheaper freight cost of $.35 to $.40 per ton from the South Carolina deposit. The use of anthracite culm in briquets at a cost of approximately $.60 to $.90 per ton as compared with $2.45 for coal, together with an advantage in freight cost, entails another appreciable saving. With the culm ordinarily available, containing approximately 20% ash, this saving would be possible only in a briquetted charge but the very recent availability upon the market of culm with 12% ash at $.90 net ton makes it possible to realize this saving with the present form of charge. (Incidentally, this information applied to present charge was worked up about three years ago and now the market conditions make it possible to utilize this knowledge.)

In the nature of savings indirectly dependent upon a briquetted charge are (1) continuous reduction of barytes, which is made possible by the avoidance of sticking of the charge, and (2) grinding by means of the Hardinge mill at Newark, the fine grinding of which would be an advantage for briquets but is objectionable at present. The list of savings is as follows:-

| | Newark | | Philadelphia | |
|---|---|---|---|---|
| Direct Savings | Tons | Value | Tons | Value |
| Crude barytes at $8.00 per ton, fob mines (1925 contract). | 12000 | $96000 | 8000 | $64000 |
| Crude barytes at $5.50 per ton, fob mines (conservatively estimated price high silica material). | 12000 | 66000 | 8000 | 44000 |
| Savings on crude barytes at $5.50 | | 30000 | | 20000 |
| Reduction in freight rate on account of shorter haul (may be as much as 40¢ per ton, but is conservatively estimated at 25¢). | 12000 | 3000 | 8000 | 2000 |
| Total savings on crude barytes | | 33000 | | 22000 |
| Cost of briquetting high silica barytes at $1.50 per ton. | 12000 | 18000 | 8000 | 12000 |
| Net savings on high silica barytes | | 15000 | | 10000 |
| Further probable savings through reduction of mine price of high silica material to $4.50. | 12000 | 12000 | 8000 | 8000 |
| Probable net savings on high silica barytes. | (a) | 27000 | | 18000 |

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| | | Newark | | Philadelphia | |
|---|---|---|---|---|---|
| | | Tons | Value | Tons | Value |
| Coal at present prices | | | | | |
| Newark, per ton del'd. | $5.23 | 2640 | $13800 | | |
| Philadelphia, per ton deld. | 4.56 | | | 1760 | $ 8000 |
| Culm at 90¢, fob mines | | | | | |
| Newark freight, per ton | 2.14 | 2640 | 8000 | | |
| Philadelphia freight,per ton | 2.29 | | | 1760 | 5600 |
| Savings on use of Culm | | (b) | 5800 | | 2400 |
| Total direct savings (a + b) | | (c) | 32800 | | 20400 |
| <u>Indirect Savings</u> | | | | | |
| Continuous reduction barytes, labor | | | 11700 | | 3900 |
| fuel | | | 7500 | | 5000 |
| Grinding in Hardinge Mill, labor | | | 4700 | | |
| Total indirect savings | | (d) | 23900 | | 8900 |
| Total savings (c + d) | | | 56700 | | 29300 |
| Total savings, Newark and Philadelphia | | | 86000 | | |

EXHIBIT NO.2.

HIGH SILICA BARYTES - PROBABLE SAVINGS

Expended 1924 - $ 3,801.60

Reduction of High Silica Barytes

It is generally recognized that silica is a very detrimental impurity in barytes and its presence in excess of 4% is undesirable in the ore used for the production of barium sulphide. As a result, only the better grade of ore is being mined which, coupled with the fact that it undergoes a purification treatment, makes its cost appreciable, while there is also the possibility of an increasing demand overtaxing the supply. At the same time there are large deposits of barytes containing from 10 to 15% silica which are unfit for this purpose at present and can be obtained at a much cheaper price than the present ore. The utilization of such ore is the object of this study. Our attention is particularly directed toward a large deposit in South Carolina containing approximately 1,000,000 tons owned by the Product Sales Corporation.

Our rather thorough study of the black ash furnacing operation in the plant, made several years ago, which set up standards for operation and yields that are at present used, had shown that one pound of silica rendered unavailable 2.7 lbs. barium sulphate. Consequently, this high silica ore would give a yield of water-soluble barium sulphide of approximately 60% in plant operation as compared with an average of 80% for an average grade of ore used by the plants and it is therefore uneconomical.

Our laboratory work using a briquetted charge, made 1-1/2 years ago had shown that this method cut down the deleterious silica reaction to a great extent. This knowledge applied to high silica ore in the present work resulted in the same inhibition of the silica action and the obtainment of a conversion of 90% to water-soluble barium sulphide. Following this a considerable amount of laboratory work successfully solved several problems in connection with these briquets, such as hardness, binder, nature of coal, fineness of materials, temperature of furnacing, and leaching of resultant black ash. Plant tests consisting of five runs, based upon laboratory experience, showed that briquets made from ore containing 85% $BaSO_4$ and 14% $SiO_2$ gave successful operation in the present rotary furnace and particularly that a conversion of 90% can be obtained in the plant. This yield is comparable with 60% which would have been obtained with this ore in the ordinary practice and with 80 to 83% obtained with present ore containing 92 to 95% $BaSO_4$ and 4 to 2.8% $SiO_2$. Due to this high conversion, the weight of barium sulphide from one ton of ore is the same as with present high grade ore. Another favorable result was the absence of sticking of the charge to the furnace walls which, besides eliminating the barring required at present, would make possible the operation of a continuous kiln for this purpose since the sticking constitutes a serious obstacle in this connection.

The use of briquets applied to low grade and high silica ore will consequently result in a considerable saving. As listed below, this consists of several items, chief of which is the difference in the cost of ore. The present cost is $8.00 (1/25/25) per ton plus $8.00 freight, while assurance of a price of $5.50 per ton for the low grade ore has been obtained and there is a possibility of a price of $4.50 per ton. There is also a cheaper freight cost of $.25 to $.40 per ton from the South Carolina deposit. The use of anthracite culm in briquets at a cost of approximately $.60 to $.90 per ton as compared with $2.45 for coal, together with an advantage in freight cost, entails another appreciable saving. With the culm ordinarily available, containing approximately 20% ash, this saving would be possible only in a briquetted charge but the very recent availability upon the market of culm with 12% ash at $.90 net ton makes it possible to realize this saving with the present form of charge. (Incidentally, this information applied to present charge was worked up about three years ago and now the market conditions make it possible to utilize this knowledge.)

In the nature of savings indirectly dependent upon a briquetted charge are (1) continuous reduction of barytes, which is made possible by the avoidance of sticking of the charge, and (2) grinding by means of the Hardinge mill at Newark, the fine grinding of which would be an advantage for briquets but is objectionable at present. The list of savings is as follows:-

| | Newark | | Philadelphia | |
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| Savings on crude barytes at $5.50 | | 30000 | | 20000 |
| Reduction in freight rate on account of shorter haul (may be as much as 40¢ per ton, but is conservatively estimated at 25¢). | 12000 | 3000 | 8000 | 2000 |
| Total savings on crude barytes | | 33000 | | 22000 |
| Cost of briquetting high silica barytes at $1.50 per ton. | 12000 | 18000 | 8000 | 12000 |
| Net savings on high silica barytes | | 15000 | | 10000 |
| Further probable savings through reduction of mine price of high silica material to $4.50. | 12000 | 12000 | 8000 | 8000 |
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| | | | Newark | | Philadelphia | |
|---|---|---|---|---|---|---|
| | | | Tons | Value | Tons | Value |
| Coal at present prices | | | | | | |
| Newark, per ton del'd. | $5.23 | | 2640 | $13800 | | |
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| Culm at 90¢, fob mines | | | | | | |
| Newark freight, per ton | 2.14 | | 2640 | 8000 | | |
| Philadelphia freight, per ton | 2.29 | | | | 1760 | 5600 |
| Savings on use of Culm | | (b) | | 5800 | | 2400 |
| Total direct savings (a + b) | | (c) | | 32800 | | 20400 |
| Indirect Savings | | | | | | |
| Continuous reduction barytes, labor | | | | 11700 | | 3900 |
| fuel | | | | 7500 | | 5000 |
| Grinding in Hardinge Mill, labor | | | | 4700 | | |
| Total indirect savings | | (d) | | 23900 | | 8900 |
| Total savings (c + d) | | | | 56700 | | 29300 |
| Total savings, Newark and Philadelphia | | | | 86000 | | |

EXHIBIT NO.2.

HIGH SILICA BARYTES - PROBABLE SAVINGS

Expended 1924 - $ 3,801.80

Reduction of High Silica Barytes

It is generally recognized that silica is a very detrimental impurity in barytes and its presence in excess of 4% is undesirable in the ore used for the production of barium sulphide. As a result, only the better grade of ore is being mined which, coupled with the fact that it undergoes a purification treatment, makes its cost appreciable, while there is also the possibility of an increasing demand overtaxing the supply. At the same time there are large deposits of barytes containing from 10 to 15% silica which are unfit for this purpose at present and can be obtained at a much cheaper price than the present ore. The utilization of such ore is the object of this study. Our attention is particularly directed toward a large deposit in South Carolina containing approximately 1,000,000 tons owned by the Product Sales Corporation.

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DUP150089425

The use of briquets applied to low grade and high silica ore will consequently result in a considerable saving. As listed below, this consists of several items, chief of which is the difference in the cost of ore. The present cost is $8.00 (1/25/25) per ton plus $8.00 freight, while assurance of a price of $5.50 per ton for the low grade ore has been obtained and there is a possibility of a price of $4.50 per ton. There is also a cheaper freight cost of $.25 to $.40 per ton from the South Carolina deposit. The use of anthracite culm in briquets at a cost of approximately $.60 to $.90 per ton as compared with $2.45 for coal, together with an advantage in freight cost, entails another appreciable saving. With the culm ordinarily available, containing approximately 20% ash, this saving would be possible only in a briquetted charge but the very recent availability upon the market of culm with 12% ash at $.90 net ton makes it possible to realize this saving with the present form of charge. (Incidentally, this information applied to present charge was worked up about three years ago and now the market conditions make it possible to utilize this knowledge.)

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| | Newark | | Philadelphia | |
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| Direct Savings | Tons | Value | Tons | Value |
| Crude barytes at $8.00 per ton, fob mines (1925 contract). | 12000 | $96000 | 8000 | $64000 |
| Crude barytes at $5.50 per ton, fob mines (conservatively estimated price high silica material). | 12000 | 66000 | 8000 | 44000 |
| Savings on crude barytes at $5.50 | | 30000 | | 20000 |
| Reduction in freight rate on account of shorter haul (may be as much as 40¢ per ton, but is conservatively estimated at 25¢). | 12000 | 3000 | 8000 | 2000 |
| Total savings on crude barytes | | 33000 | | 22000 |
| Cost of briquetting high silica barytes at $1.50 per ton. | 12000 | 18000 | 8000 | 12000 |
| Net savings on high silica barytes | | 15000 | | 10000 |
| Further probable savings through reduction of mine price of high silica material to $4.50. | 12000 | 12000 | 8000 | 8000 |
| Probable net savings on high silica barytes. | (a) | 27000 | | 18000 |

DUP150089426

| | | Newark | | Philadelphia | |
|---|---|---|---|---|---|
| | | Tons | Value | Tons | Value |
| Coal at present prices | | | | | |
| Newark, per ton del'd. | $5.23 | 2640 | $13800 | | |
| Philadelphia, per ton deld. | 4.56 | | | 1760 | $ 8000 |
| Culm at 90¢, fob mines | | | | | |
| Newark freight, per ton | 2.14 | 2640 | 8000 | | |
| Philadelphia freight, per ton | 2.29 | | | 1760 | 5600 |
| Savings on use of Culm | | (b) | 5800 | | 2400 |
| Total direct savings (a + b) | | (c) | 32800 | | 20400 |
| Indirect Savings | | | | | |
| Continuous reduction barytes, labor | | | 11700 | | 3900 |
| fuel | | | 7500 | | 5000 |
| Grinding in Hardinge Mill, labor | | | 4700 | | |
| Total indirect savings | | (d) | 23900 | | 8900 |
| Total savings (c + d) | | | 56700 | | 29300 |
| Total savings, Newark and Philadelphia | | | 86000 | | |

EXHIBIT NO. 3

LIQUID SULPHUR DIOXIDE - CALCULATION OF SAVINGS

| | | |
|---|---|---|
| Manufactured, 1924 (av. price .0555) | 702,000 | $38,961. |
| Purchased, 1924 (av. price .0485) | 515,000 | 24,977. |
| Total manufactured and purchased, 1924 | 1,217,000 | 63,938. |
| Cost of same at old purchase price (.061) | 1,217,000 | 74,237. |
| Saving effected, assuming present purchase price (.0485) to be due to fact that we have plant in operation, approximately - | | 10,300. |
| Manufactured, Oct.-Dec. 1924 (av. .0299) | 341,000 | 10,196. |
| Cost of same at old purchase price (.061) | 341,000 | 20,801. |
| Saving effected on three months production | | 10,605. |
| Estimated Savings, 1925: | | |
| Total requirements if purchased at .0485 | 1,250,000 | 60,625. |
| Total requirements if produced at .0299 | 1,250,000 | 37,375. |
| Estimated savings, 1925 | | $23,250. |

This estimate is made on a strictly competitive basis, with no consideration given to the effect that the operation of our plant has on the market price.

E-11"

DUP150089428

EXHIBIT NO. 3

LIQUID SULPHUR DIOXIDE - CALCULATION OF SAVINGS

| | | |
|---|---|---|
| Manufactured, 1924 (av. price .0555) | 702,000 | $38,961. |
| Purchased, 1924 (av. price .0485) | 515,000 | 24,977. |
| Total manufactured and purchased, 1924 | 1,217,000 | 63,938. |
| Cost of same at old purchase price (.061) | 1,217,000 | 74,237. |
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| Cost of same at old purchase price (.061) | 341,000 | 20,801. |
| Saving effected on three months production | | 10,605. |

Estimated Savings, 1925:

| | | |
|---|---|---|
| Total requirements if purchased at .0485 | 1,250,000 | 60,625. |
| Total requirements if produced at .0299 | 1,250,000 | 37,375. |
| Estimated savings, 1925 | | $23,250. |

This estimate is made on a strictly competitive basis, with no consideration given to the effect that the operation of our plant has on the market price.

E-11"

EXHIBIT NO. 3

LIQUID SULPHUR DIOXIDE - CALCULATION OF SAVINGS

| | | |
|---|---|---|
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| | | |
|---|---|---|
| Total requirements if purchased at .0485 | 1,250,000 | 60,625. |
| Total requirements if produced at .0299 | 1,250,000 | 37,375. |
| Estimated savings, 1925 | | $23,250. |

This estimate is made on a strictly competitive basis, with no consideration given to the effect that the operation of our plant has on the market price.

E-11"

DUP150089429

EXHIBIT NO. 4

Fabrikoid Division
Newburgh, N.Y.

February 10, 1925.

CONFIDENTIAL

DR. HAMILTON BRADSHAW,
ASST. CHEMICAL DIRECTOR.

YOUR LETTER FEBRUARY 3.
YOUR FILE ES-370-30.

According to our #1 Forecast of the 1925 production, we will make approximately 7-1/2 million Stads this year. Our net solvent saving as calculated by Mr. Stimpson is 1-1/2¢ per Stad if we use activated carbon for all our production. However, we estimate that we will get only 90% of our goods coated with this recovery, and therefore the saving should be 7-1/2 million times 1-1/2¢ times 90%, or approximately $100,000.

While we might calculate some saving on labor, it is wiser for the present to leave this out. As to the safety feature, however, we have already had a very good demonstration of the real value of activated carbon solvent recovery.

On February 3rd, we had a fire on #21 machine that was very similar to previous fires which have caused the destruction of two coating machines at a time. The fire was promptly put out with an extinguisher, and they were coating again within ten minutes. I am fully convinced that with the old type coating machines we would have lost them both, at a loss of approximately $15,000.

G. T. BRISTOL - PLANT MANAGER.

(3) G. T. B.

GTB;MM
E-11"

DUP150089430

EXHIBIT NO. 4

Fabrikoid Division
Newburgh, N.Y.

February 10, 1925.

CONFIDENTIAL

DR. HAMILTON BRADSHAW,
ASST. CHEMICAL DIRECTOR.

YOUR LETTER FEBRUARY 3.
YOUR FILE ES-370-30.

According to our #1 Forecast of the 1925 production, we will make approximately 7-1/2 million Stads this year. Our net solvent saving as calculated by Mr. Stimpson is 1-1/2¢ per Stad if we use activated carbon for all our production. However, we estimate that we will get only 90% of our goods coated with this recovery, and therefore the saving should be 7-1/2 million times 1-1/2¢ times 90%, or approximately $100,000.

While we might calculate some saving on labor, it is wiser for the present to leave this out. As to the safety feature, however, we have already had a very good demonstration of the real value of activated carbon solvent recovery.

On February 3rd, we had a fire on #21 machine that was very similar to previous fires which have caused the destruction of two coating machines at a time. The fire was promptly put out with an extinguisher, and they were coating again within ten minutes. I am fully convinced that with the old type coating machines we would have lost them both, at a loss of approximately $15,000.

G. T. BRISTOL - PLANT MANAGER.

(S) G. T. B.

GTB;MM
E-11"

EXHIBIT NO. 4

Fabrikoid Division
Newburgh, N.Y.

February 10, 1925.

CONFIDENTIAL

DR. HAMILTON BRADSHAW,
ASST. CHEMICAL DIRECTOR.

YOUR LETTER FEBRUARY 3.
YOUR FILE ES-370-30.

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G. T. BRISTOL - PLANT MANAGER.

(S) G. T. B.

GTB;MM
E-11"

DUP150089431

EXHIBIT NO.5.

STRONTIUM NITRATE - ACCOUNT 3-800-A-2

Expended 1924 - $2760.51

Time of Study - February, March, April & May, 1924

The study of the manufacture of strontium nitrate was undertaken primarily to prove the feasibility of using calcium nitrate as the nitrate radical source in the manufacture of strontium nitrate. Before completion, however, this study included:-

(1) Use of calcium nitrate as nitrate radical source.
(2) A modernization of the present process.
(3) Use of ammonia oxidation acid in the present process.

Some experimental work was done for numbers 1 and 2. Cost estimates with general plant design in conjunction with the Engineering Department were made for all three. It was found that:

(1) The use of calcium nitrate as a nitrate radical source is possible, but involves some difficulties. Essentially, the process consists of the direct addition of solid calcium nitrate to strontium black ash leach liquor of the highest possible concentration and followed by filtration and evaporation. Recrystallization is necessary to obtain a sufficiently pure product. Modifications to avoid this last step have proved impractical. It was found that on a 200 ton monthly production basis a yearly saving of $30,900 was indicated, but with a plant installation cost of $65,000, of which $55,000 would be net investment increase.

(2) Modernization of the present process showed a considerable saving. These changes are:-

(a) Substitution of hot wet grinding of celestite and soda ash for the present dry grinding and subsequent digestion steps. Small scale hot grinds were made at the Experimental Station. One large scale unheated grind was made at the Philadelphia Plant. These grinds uniformly were successful.

(b) Substitution of an Oliver Filter and Dorr Equipment for the present wash-tub system.

The installation of this equipment shows an annual saving on the same 200 ton monthly production basis of $17,600, with a new equipment cost of $28,000 and a net investment increase of $1,000.

(3) The general design of and cost estimates for an ammonia oxidation plant to produce nitric acid for strontium nitrate manufacture showed a saving in nitric acid cost of $49,000 per annum, which, when combined with the probable profit on the sodium nitrite by-product increased these savings to $80,000 per annum. The estimated installation cost of this ammonia oxidation plant was $129,000.

The installation of the new equipment was recommended. The ammonia oxidation plant would necessarily be constructed primarily as an experimental unit, later to be used in regular plant operation.

The following table gives a summary of the estimated annual savings, should the different processes studied be adopted.

| Saving in Item | Calcium Nitrate Strontium-Black Ash Process | Modernization of present process | Ammonia Oxidation Process |
|---|---|---|---|
| Ingredients | $ 50,100 | None | $ 49,000 |
| Operating Labor | - 3,660 | $ 6672 | |
| Repair Labor | - 1,332 | 1164 | |
| Maintenance Materials | - 1,092 | 1020 | |
| Power | + 240 | 8760 | |
| Oil | - 9,458 | None | |
| By-product Credit | - 3,840 | None | $ 80,000 if nitrite be sold at an expected profit |
| Total Savings . . . . . . | $ 30,960 | $17,618 | $ 49,000 |
| Plant Installation Cost . | $ 65,000 | $28,000 | $129,000 |
| Net Investment Increase . | $ 55,000 | $ 1,000 | - |

Note:- It should be noted that should the ammonia oxidation plant be constructed, its saving would be added to that of the modernization of the present process, should those changes be made.

DUP150089433

EXHIBIT NO.5.

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Expended 1924 - $2760.51

Time of Study - February, March, April & May, 1924

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(1) Use of calcium nitrate as nitrate radical source.
(2) A modernization of the present process.
(3) Use of ammonia oxidation acid in the present process.

Some experimental work was done for numbers 1 and 2. Cost estimates with general plant design in conjunction with the Engineering Department were made for all three. It was found that:

(1) The use of calcium nitrate as a nitrate radical source is possible, but involves some difficulties. Essentially, the process consists of the direct addition of solid calcium nitrate to strontium black ash leach liquor of the highest possible concentration and followed by filtration and evaporation. Recrystallization is necessary to obtain a sufficiently pure product. Modifications to avoid this last step have proved impractical. It was found that on a 200 ton monthly production basis a yearly saving of $30,900 was indicated, but with a plant installation cost of $65,000, of which $55,000 would be net investment increase.

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| Total Savings . . . . . . | $ 30,960 | $17,618 | $ 49,000 |
| Plant Installation Cost . | $ 65,000 | $28,000 | $129,000 |
| Net Investment Increase . | $ 55,000 | $ 1,000 | - |

Note:- It should be noted that should the ammonia oxidation plant be constructed, its saving would be added to that of the modernization of the present process, should those changes be made.

DUP150089435

EXHIBIT NO.6.

ZINC LIQUOR PURIFICATION - ACCOUNT S-800-A-22

Expended 1924 - $ 3520.41

The fundamental study of the deleterious effect of impurities in the zinc liquor on the properties of the finished lithopone pointed very clearly to the need for improved methods for their removal. The net result of the experimental work on zinc liquor purification has been to diminish the amount of zinc required, to speed up the reaction, and to render more complete the removal of impurities. A by-product of the investigation was the development of a method for recovering the zinc value in the spent zinc dust sludge. The work may be summarized in dollars and cents somewhat as follows: During the first nine months of 1924, zinc dust was used at the rate of 396,000 pounds for 12,000 tons of Gold Seal lithopone produced. Its value at $.0745 was $29,500; the new process requires not more than 135,000 pounds at $.0745 per pound, equals $10,058. If the cost of zinc dust is taken at $.095 per pound, the savings become the difference between $37,620 (instead of $29,500) and $12,825 (instead of $10,058). The savings, therefore, amount to somewhere between $19,500 per year and $24,795 at capacity production. This saving, however, might be regarded as reduced by the fact that the experimental work resulted in developing a method requiring less zinc dust than the amounts just quoted. The amounts just quoted were the amounts required before the improvements were made; however, since not only the amount of zinc dust has been reduced but methods developed for the recovery of the zinc value of the sludge and since the savings are applicable not only to the Gold Seal but to the Green Seal lithopone manufacture, the net result may best be summarized as follows:

| | 1924 at $.0745 | 1/25/25 at $.095 |
|---|---|---|
| 396,000# Zinc Dust | $ 29502.00 | $ 37620.00 |
| Deduct 135,000# Zinc Dust | 10058.00 | 12825.00 |
| Net Saving on Gold Seal (12000 Tons) | $ 19444.00 | $ 24795.00 |
| Recovery on Gold Seal | $ 4740.00 | $ 6000.00 |
| Saving on Green Seal (7200 Tons) | $ 11668.00 | $ 14877.00 |
| Recovery on Green Seal | $ 2844.00 | $ 3600.00 |
| Total Saving | $ 38694.00 | $ 49272.00 |

EXHIBIT NO.6.

ZINC LIQUOR PURIFICATION - ACCOUNT S-800-A-23

Expended 1924 - $ 3520.41

The fundamental study of the deleterious effect of impurities in the zinc liquor on the properties of the finished lithopone pointed very clearly to the need for improved methods for their removal. The net result of the experimental work on zinc liquor purification has been to diminish the amount of zinc required, to speed up the reaction, and to render more complete the removal of impurities. A by-product of the investigation was the development of a method for recovering the zinc value in the spent zinc dust sludge. The work may be summarized in dollars and cents somewhat as follows: During the first nine months of 1924, zinc dust was used at the rate of 396,000 pounds for 12,000 tons of Gold Seal lithopone produced. Its value at $.0745 was $29,500; the new process requires not more than 135,000 pounds at $.0745 per pound, equals $10,058. If the cost of zinc dust is taken at $.095 per pound, the savings become the difference between $37,620 (instead of $29,500) and $12,825 (instead of $10,058). The savings, therefore, amount to somewhere between $19,500 per year and $24,795 at capacity production. This saving, however, might be regarded as reduced by the fact that the experimental work resulted in developing a method requiring less zinc dust than the amounts just quoted. The amounts just quoted were the amounts required before the improvements were made; however, since not only the amount of zinc dust has been reduced but methods developed for the recovery of the zinc value of the sludge and since the savings are applicable not only to the Gold Seal but to the Green Seal lithopone manufacture, the net result may best be summarized as follows:

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| Recovery on Green Seal | $ 2844.00 | $ 3600.00 |
| Total Saving | $ 38694.00 | $ 49272.00 |

EXHIBIT No. 7.

WHITE LEAD - Accounts 8-800-C-1 & 9-901-A

(Expended, 1924 - $5,612.15)

JANUARY, 1924 - JUNE-DECEMBER, 1924.

This problem was taken up by the Chemical Department to give the assistance necessary in developing a satisfactory unit for the manufacture of Carter Lead with proper operating conditions of the same. This work is based on the results obtained with an autoclave operating at atmospheric pressure (see Engineering Department Account MX-202). In 1923 and the early part of 1924 it was shown in a 4' d. x 12' reel taking a 4,000-pound charge that 72-hour corrosion producing a satisfactory grade of white lead was possible. This lead was equal to the plant output in all respects except color. In color, it was superior.

In 1924 a full-sized plant unit 8' d. x 12' was installed. The capacity of this unit is 16,000 pounds of blue lead with an overload capacity of 20,000 pounds. Twenty-two runs were made on this reel in 1924 and January, 1925, the last seven of which were satisfactory. It was found that 72 to 80-hour corrosion was possible with everything pointing toward a still lower figure. The grade of White Lead produced was superior to that produced in the present plant, in hiding power (25%), tinting strength (10%), and color (2 points Beckton Standard), and the oil absorption was apparently controllable. The essential differences between this process and the ordinary Carter process are:

(1) Larger and improved units; Carter process - 6700-lb. charge; new process - 16,000-lb. charge.

(2) Greater reel speed; Carter - 0.2 r.p.m.; new process 0.95 r.p.m.

(3) Mechanical spraying - S. & K. nozzles on a fixed spray line with semi-automatic control--cf. coarse hand spray of the Carter process.

(4) Half-hour spraying periods with acid used at intervals during the run --cf. 8 to 10-hour spraying period acid concentrated at early part of run -- Carter process.

(5) Close control of humidity and temperature. Optimum conditions found 70°C. for the entering gas with 75% relative humidity or 90 grams per cubic meter of water absorbable whatever the temperature--cf. no humidity control -- Carter process

(6) Close $CO_2$ control. Average desired--8-1/2% $CO_2$ by volume--cf. very rough control--Carter process.

(7) Gas tight apparatus resulting in no dust losses and is very sanitary--cf. exit gases in Carter process escape into the reel room.

(8) Single stage corrosion--no intermediate, unsanitary disintegration step--cf. two-stage operation with disintegration with the Carter process.

A modern lead plant was designed by R. L. Holliday, of the Engineering Department, with these units for the basic plant process. Other changes from the present method are: (1) Closed system throughout, eliminating any dust hazard; (2) Improved blowing similar to that used by the National Lead Co.; (3) Closed recovery system, using a hydroseparator, ball mill, bowl and table classifier and thickener, all blue lead tailings being returned for further corrosion. These changes form an essential part of the process developed in this study. The savings embodying this whole system are computed by Mr. Holliday and Mr. Iliff on 80% present plant capacity:

ESTIMATE OF SAVINGS

| | | | |
|---|---|---|---|
| 1. | Present Permanent Investment | | $242,138.22 |
| 2. | Addl. for taking over 73 Bldg. complete. | | 56,918.00 |
| | | | 299,056.22 |
| 3. | Credit Carter Lead Plant Investment | | |
| | 32 Bldg. | $41,293.00 | |
| | 33 " | 43,934.00 | |
| | 41 " | 64,413.00 | |
| | 48 " | 43,627.00 | |
| | 37 " | 20,138.00 | 213,410.00 |
| 4. | Cash Outlay | | 253,200.00 |
| 5. | Net increase permanent investment | | 96,708.00 |
| 6. | Savings effected annually | | |
| | Labor | $21,863.00 | |
| | Maint | 27,129.00 | |
| | Yield | 22,716.00 | |
| | Power (fuel only) | -------- | |
| | | | 71,708.00 |
| 7. | Depreciation on No. 5 at 3% | 2,900.00 | |
| | Taxes at .90 per $100 | 870.00 | |
| | Insurance (property) .40 per $100 | 387.00 | 4,157.00 |
| 8. | Net Savings effected annually | | $67,551.00 |
| 9. | Return on cash outlay | | 26.7% |

The reduction in labor is large, the crew being reduced from 30 to 15 men.

(Sgd.) R.L.Holliday (Eng. Dept.)

" John W. Iliff (Chem. Dept.)

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(Sgd.) R.L.Holliday (Eng. Dept.)

" John W. Iliff (Chem. Dept.)

EXHIBIT No. 8

ESTER GUM - ESTIMATE OF SAVINGS.

(Expended, 1924 - $1074.94).

W. W. Rosin at $7.80 per bbl. of 280 lbs. = .02785 per lb.

Glycerin - 18-1/2¢ per lb.

Freight not taken into consideration, as it is thought the freight on purchased Ester Gum would about offset freight on raw materials for manufacture of Ester Gum.

| | |
|---|---|
| Rosin - 100 lbs. at .02785 | 2.785 |
| Glycerin - 12-1/2 lbs. at .185 | 2.3125 |
| Materials cost per 100 lbs. Rosin | 5.0975 |
| Yield at 97% weight of Rosin = 97 lbs. | |
| Materials cost per lb. Ester Gum produced | .05255 |
| Other costs - estimated | .02000 |
| Total cost per lb. Ester Gum | .07255 |

1924 Consumption Ester Gum - First six months:

| | | |
|---|---|---|
| Philadelphia | 10039 lbs. | |
| Everett | 12375 " | |
| Chicago | 38851 " | 61265 lbs. |

Year's requirements on basis of 6 months' consumption - 122530 lbs.

| | | | | |
|---|---|---|---|---|
| Cost of purchased Ester Gum - | 122530 lbs. | at | .1025 | $12559. |
| Cost of producing Ester Gum - | 122530 " | " | .07255 | 8890. |
| Possible yearly savings | | | | 3669. |

Note: There has been an advance in the price of W. W. Rosin, quotation in Oil, Paint & Drug Reporter January 26 showing $10.50 per bbl. It is felt, however, that the price of Ester Gum will advance in sympathy with the Rosin market, and that the figures given above represent the probable saving. With Rosin at $10.50 the cost of producing Ester Gum would go up about 1¢ per lb.

EXHIBIT No. 8

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(Expended, 1924 - $1074.94).

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DUP150089443

EXHIBIT No. 8

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Glycerin - 18-1/2¢ per lb.

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| Cost of producing Ester Gum - | 122530 " " | .07255 | 8890. |
| Possible yearly savings | | | 3669. |

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DUP150089443

EXHIBIT NO. 9.

OXIDATION OF AMMONIA - ESTIMATE OF SAVINGS.

(Expended, 1924 - $10860.03)

| | |
|---|---|
| Engineering Department's summary of costs for the pressure oxidation system, shows operating costs, per ton 100% $HNO_3$ equivalent | $12.215 |
| Summary shows cost of Ammonia (consumed at 92% overall efficiency) at 10¢ per lb. - $58.85; at 11¢ per lb. - 64.74 | |
| Calculating from these figures, with Ammonia at 10-1/4¢ (present price) the cost per ton of 100% $HNO_3$ equivalent is | 60.323 |
| Cost of producing 70% $HNO_3$ as equivalent 100% $HNO_3$ | 72.54 |
| Cost per pound | .03627 |
| Concentration to 98% $HNO_3$ - Cost per lb. 100% $HNO_3$ | .00732 |
| Total cost per lb. 100% $HNO_3$ equivalent | .04359 |
| Cost 100% $HNO_3$ at Repauno (supplied by Explosives Dept.-Chem. Section) | .049 |
| Difference in favor of Ammonia Oxidation, per lb. | .00541 |
| Saving per ton 100% $HNO_3$ equivalent | 10.82 |
| Saving on 20000 tons (Repauno's yearly output) | $216,400.00 |

## EXHIBIT NO. 9.

### OXIDATION OF AMMONIA - ESTIMATE OF SAVINGS.

(Expended, 1924 - $10860.03)

| | |
|---|---|
| Engineering Department's summary of costs for the pressure oxidation system, shows operating costs, per ton 100% $HNO_3$ equivalent | $12.215 |
| Summary shows cost of Ammonia (consumed at 92% overall efficiency) at 10¢ per lb. - $58.85<br>at 11¢ per lb. - 64.74 | |
| Calculating from these figures, with Ammonia at 10-1/4¢ (present price) the cost per ton of 100% $HNO_3$ equivalent is | 60.333 |
| Cost of producing 70% $HNO_3$ as equivalent 100% $HNO_3$ | 72.54 |
| Cost per pound | .03627 |
| Concentration to 98% $HNO_3$ - Cost per lb. 100% $HNO_3$ | .00732 |
| Total cost per lb. 100% $HNO_3$ equivalent | .04359 |
| Cost 100% $HNO_3$ at Repauno (supplied by Explosives Dept.-Chem. Section) | .049 |
| Difference in favor of Ammonia Oxidation, per lb. | .00541 |
| Saving per ton 100% $HNO_3$ equivalent | 10.82 |
| Saving on 20000 tons (Repauno's yearly output) | $216,400.00 |

EXHIBIT NO. 10.

CRYPTOX

The rapidly increasing demand for white pigments possessing superior hiding power has prompted a detailed investigation of the production of our proposed new pigment, named Cryptox. A preliminary laboratory study of the problem yielded very favorable results. Later, the pigment was prepared in semi-works equipment, whereby a product slightly superior to that obtained in the laboratory was produced without difficulty. With the possible exception of a small additional amount of fundamental study, the project is now ready for plant-scale trial. No serious difficulties are anticipated for plant production of the material.

The superior quality of Cryptox can best be observed by comparing the material with Titanox, which in turn is rapidly gaining in popularity primarily due to the fact that it possesses the highest hiding power among all present commercial white pigments. (The hiding power of Titanox is 10% greater than that of Gold Seal lithopone.) Cryptox, however, possesses a hiding power 25% greater than that of Titanox, and is likewise far superior to the latter in color. In other respects, Cryptox equals the high quality of our present Gold Seal lithopone. It is our opinion that Cryptox represents the nearest approach to an ideal white pigment at present available.

We believe that the production of this new pigment would be a very profitable undertaking for the Paint Department. Our cost calculations show that if the by-product of the process, i.e., blanc fixe, be sold at 4.2¢ per pound (present market price 4.5¢ per pound at Philadelphia), the total cost of Cryptox would be not more than 6.0¢ per pound. In other words, the total cost per pound of Cryptox would be about 3/4¢ to 1¢ higher than that of Gold Seal lithopone.

Titanox now sells for 13-1/2¢ per pound at St. Louis, or more than twice the estimated cost of Cryptox, and its production has rapidly increased to about 35 tons per day. Bearing in mind the fact that Cryptox possesses a hiding power 25% greater that that of Titanox, a very conservative estimate for a selling price of our new pigment may be placed at 8¢ per pound, this figure being based upon the selling price of Gold Seal lithopone and the relative hiding powers of the latter and Cryptox. The profit to be gained by marketing the new pigment would therefore amount to at least 2¢ per pound. Hence, on the basis of a production of 25 tons of Cryptox per day, the profits would approximate a minimum of $350,000 per year. We are of the opinion that this project presents an exceptionably favorable outlook and should be given serious consideration toward further development.

| | White Lead | Titanox | Gold Seal | Cryptox |
|---|---|---|---|---|
| Total cost per lb. | 10-1/2¢ | ? | 5¢ | 6¢ |
| Probable selling price | 11¢ | 13-1/2¢ | 6¢ | 13¢ |
| Relative hiding power | .50 | 1.10 | 1.00 | 1.35 |
| Consumer's cost per unit hiding power | 19¢ | 9¢ | 5¢ | 4-1/2¢ |

E-11*

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| | White Lead | Titanox | Gold Seal | Cryptox |
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| Total cost per lb. | 10-1/2¢ | ? | 5¢ | 6¢ |
| Probable selling price | 11¢ | 13-1/2¢ | 6¢ | 12¢ |
| Relative hiding power | .50 | 1.10 | 1.00 | 1.35 |
| Consumer's cost per unit hiding power | 19¢ | 9¢ | 5¢ | 4-1/2¢ |

E-11*

EXHIBIT NO. 11.

DRY COLORS (YELLOWS) -- POSSIBLE YEARLY SAVINGS

(Expended 1924, - $10,020.44)

The first step in this study was a careful determination of the yields and losses. Of the tribasic lead acetate used 8% to 10% is lost, the major part remaining unprecipitated from solution after addition of the chromate. Losses of chromate were less, being about 2% of the amount used.

The second step was to develop reliable laboratory methods for making yellows, by which suggestions for reducing the cost could be tested. This was done for the three most important yellows.

Survey of possible yearly savings to be made:

| | | |
|---|---|---|
| (1) | Recovery of Acetic Acid by formation of lead sulphate or carbonate as an intermediate step. | $37,100.00 |
| (2) | Substitution of commercial alum for iron-free alum. | 3,170.00 |
| (3) | Elimination of lead used in excess of formula requirements. | 4,680.00 |
| (4) | Elimination of excess materials called for by present formulae. | 12,980.00 |
| (5) | Saving due to use of scrap lead or cheaper lead materials. | 16,700.00 |
| (6) | Labor saving by improved equipment. | 4,080.00 |
| | Total possible savings revealed by survey | $78,690.00 |

The use of scrap lead was shown by small scale and plant scale tests to be practicable and the effect of various metallic impurities on the quality of the yellows was determined.

Altogether, the outlook is very promising for making substantial savings.

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