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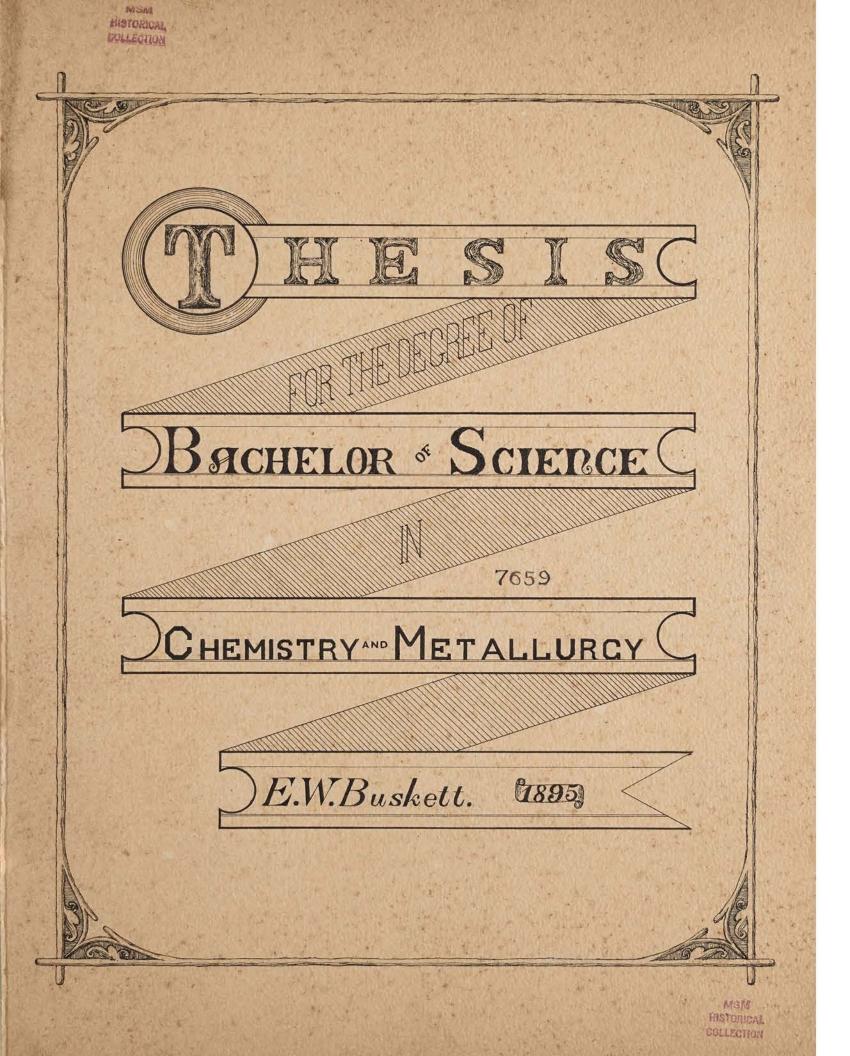
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THESIS

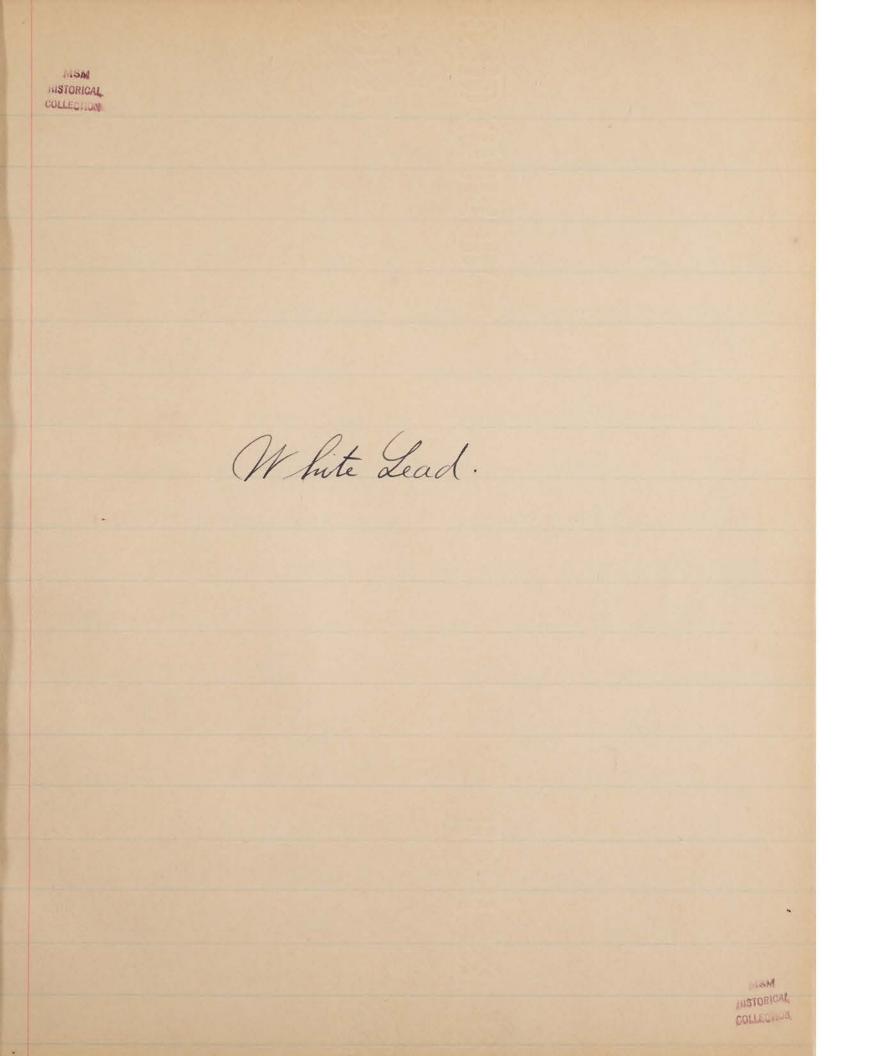
WHITE LEAD BUSKETT

1895



THESIS FOR THE DEGREE OF IN E. W. Buskett. 1895

BACHELOR OF SCIENCE CHEMISTRY AND METALLURGY



White Lead.

White Lead. HISTORICAL GLLECTION Whitehad is a hydrated contor at of lead Of the many formulae grove 2.Pb. CO, Pb(1+0)2 is probably the mast acceptable, but the amounts of Pt CO3 and Pb (140)2 vary very much in The products of different factories. Good while lead is an amorphous white pigment posers ing grat apacity density, and covering powir, and the poperty of drying quickly when mixed with linsud, or smilaroil, and exposed to air. The hydroxide combins with the sel forming a white clostic coating or paint; but lead hydroxide prosses but little apacity which is given by the corbonate. Thus it will be sur That both are assertial when a good paint is disind. White lead is used to agnat extent with other pigments, to server as Their base, and to give there body and enable this to dry quickly.

(1)White Lead. White lead is a hydrated carbonate of lead. Of the many formulae given 2PbCO₃.Pb(HO)₂ is probably the most acceptable, but the amounts of PbCO₃ and Pb(HO)₂ vary very much in the products of different factories. Good white lead is an amorphous white pigment possessing great opacity, density, and covering power, and the property of changing quickly when mixed with linseed, or similar oil, and exposed to air. The hydroxide combines with the oil forming a white elastic coating or paint; but lead hydroxide posesses but little opacity which is given by the carbonate. Thus it will be seen that both are essential when a good paint is desired. White lead is used to a great extent with other pigments, to serve as their base, and to give them body and enable them to dry quickly.

White lead was known to the accients under its Inch name printhing or its Roman name cenissa. The earliest account of the process of manuefacture is by Theophrastus in his "History of Stonis writer about 300, B.C. He describes the process as follows: "Lead is pland in earther vessels over sharp vinegar, and after it has agained some Thickness of a sort of nest, which it commany does in about tere days, they open the vessels and scrape it off as it were, in a sort of fouluess; they then place the lead over the virugar again, repeating over and our again the same wethod of scraps ing it till it has wholly dissolved. What has been scraped off they there beat to powder and boil for a long time, and what at last subsides to the bottom of the vissel is cense. (itmines, a Rouare architect of the first century B.C., says: "It will he proper to explain in what manuer white

While lead was known to the ancients under its Greek name psimithium or its Roman name cerussa.

The earliest account of the process of manufacture is by Theophrastus in his "History of Stones" written about 300 B.C. He describes the process as follows: "Lead is placed in earthen vessels over sharp vinegar, and after it has acquired some thickness of a sort of rust, which it commonly does in about ten days, they open the vessels and scrape it off, as it were, in a sort of foulness; they then place the lead over the vinegar again, repeating over and over again the same method of scraping it till it has wholly dissolved. What has been scraped off they then beat to powder and boil for a long time, and what at last subsides to the bottom of the vessel is ceruse." Vitruvius, a Roman architect of the first century B.C., says: "It will be proper to explain in what manner white

(2)

lead is made. The Rhodians place in the bottom of large vessels a layer of vine twigs, our which they four vingar, and on the tivigs they lay massis of liad. The versels are covered to prevent eraporation, and when after a certain time, they are apured the masses are found changed into white lead." Pling, our hundred years later, says, "Prinithing, which is also known as cerussa, is another production of the ladworks, and the most isteered comes from Rhodis. Pluny discribes the frours as follows: "It is made for very five shorings of lead placed over a vessel filled with the strongest villegar, by which means the shorings become diss alved; that which falls into the inegar is fint dried and they pounded and sift ed, after which it is again mixed with vinegar and is the divided into tablets and duct in the sur during summer

(3)

lead is made. The Rhodians place in the bottom of large vessels a layer of vine twigs, over which they pour vinegar, and on the twigs they lay masses of lead. The vessels are covered to prevent evaporation, and when, after a certain time, they are opened the masses are found changed into white lead." Pliny, one hundred years later, says, "Psimithium, which is also known as cerussa, is another production of the lead works, and the most esteemed comes from Rhodes." Pliny describes the process as follows: "It is made from very fine shavings of lead placed over a vessel filled with the strongest vinegar, by which means the shavings become dissolved; that which falls into the vinegar is first dried and then pounded and sifted, after which it is again mixed with vinegar and is then divided into tablets and dried in the sun during summer.

---- It is also made in another way. The lead is throw into jars filled with wicegar, which are pept closed for tendays; The sort of mould which forms upon the surface is there scraped off, and The lead is again put into the vinegar until The whde is consumed. Dioscondes, who wrote, in the first or record cerebury, a work an Anatina hudica and Bohany, 2ays; "Ceruse is made in the following manner; having pound vuegar, as sharp as possible, into a broad monthed pitcher, or an earther far, faster finily a mass of lead marthetop of the jar upon a mat of neds, provide sly stratched burath, and throw over The jar a cover, that the vinegarmay not waporate mutil the lead, dissolred and dripping down like rain,

.... It is also made in another way. The lead is thrown into jars filled with vinegar, which are kept closed for ten days; the sort of mould which forms upon the surface is then scraped off, and the lead is again put into the vinegar until the whole is consumed."

Dioscorides, who wrote, in the first or second century, a work on Materia Medica and Botany, says; "Ceruse is made in the following manner; having poured vinegar, as sharp as possible, into a broad mouthed pitcher, or an earthen jar, fasten firmly a mass of lead near the top of the jar upon a mat of reeds, previously stretched beneath, and throw over the jar a cover, that the vinegar may not evaporate until the lead, dissolved and dripping down like rain,

(4)

has disappeared; Then having strained off The clear water, which muains upon the sur fare, pour into a vessel that which is vis cid; This must be driedice the sur presently pulninged in a hand will, or in some other manner, and sight; afterwards what we mains hord or solid must be reduced to five particles and likewise sifted; The same forocess much be repeated in ture three or four times. That is best which first passes through The sieve, and this must also be employed for the selief the eyes; that whicks wext sighed out holds the second place, and in succession theothis in Their order. Others, having suspurded a stick of wood about the unddle of the jar, place the mat of Twigs before were Troud uponit, in such a manuer that it may not touch the veregar, and throw in The liad,

has disappeared; then having strained off the clear water, which remains upon the surface, pour into a vessel that which is viscid; this must be dried in the sun, presently pulverized in a hand mill, or in some other manner, and sifted; afterwards what remains hard or solid must be reduced to fine particles and likewise sifted; the same process must be repeated in turn three or four times. That is best which first passes through the sieve, and this must also be employed for the relief of the eyes; that which is next sifted out holds the second place, and in succession the others in their order. Others, having suspended a stick of wood about the middle of the jar, place the mat of twigs before mentioned upon it, in such a manner that it may not touch the vinegar, and throw in the lead,

(5)

putting on a cover and sealing it Tightly, After tendays, muring the cover, they look in, and when the matinal has been dissolved they complete the athen operation as we have described." Dioscorides says that This maybe done in winter, 2 youplace the jar over braziens, cauldrous, or furnaces; for hear applietto it show The sauce effect as the sure?" This without however, and not acceptable in modum, as they do not provide for the presence of conton dioxide, and Dios corides above mentions the med of heat. It is clear that following out Thise methods to alither, lead aretate would be forduced. Lad autah was used in medicing while white lead is muttored by Plinyas a pigment for which purpose lead aretak is not adapted. Both however were known

putting on a cover and sealing it tightly. After ten days, removing the cover, they look in, and when the material has been dissolved they complete the other operation as we have described." Dioscorides says that this may be done in winter, "If you place the jar over braziers, cauldrons, or furnaces; for heat applied to it shows the same effect as the sun."

These methods, however, are not acceptable in modern, as they do not provide for the presence of carbon dioxide, and Dioscorides above mentions the need of heat. It is clear that, following out these methods to a letter, lead acetate would be produced. Lead acetate was used in medicines while white lead is mentioned by Pliny as a pigment, for which purpose lead acetate is not adapted. Both however were known

(6)

(7)as cerussa. The ancients clearly understood the musity of supporting the leadant of content with the ninegar. It is, however, prower that the carbon dioxide came from the decomposition of the villgar; as at Rlagenfurth, in Cerinthia, when white lead is made in chambers, the autic and and carbon deoxed being sumbaneously produced by fermentahoug extract of dried grapes or raisius, or, the maidule of grapes after prossing. I or a muber of centuries the while liad demand was met by the prests in monastinis, allour Europe. The first place where white lead was made a comunial article, was Venice which for a long time supplied The gratuport of the demand. This methods use after wards used in

(7)

as cerussa. The ancients clearly understood the necessity of supporting the lead out of contact with the vinegar. It is, however, known that the carbon dioxide came from the decomposition of the vinegar, as at Klagenfurth, in Carinthia, where white lead is made in chambers, the acetic acid and carbon dioxide being simultaneously produced by fermentation of extract of dried grapes or raisins, or, the residue of grapes after pressing. For a number of centuries the white lead demand was met by the priests in monasteries, all over Europe. The first place where white lead was made a commercial article, was Venice, which for a long time supplied the greater part of the demand. Their methods were afterwards used in

(8) Holland and England and became prover as the butch withod." . Then are a great many methods employed in the manufacture of white lead but only the most important of Hore will be described in detail. These are three in muchon 1st The Dutch; zud The English ; 34d The Fruch; taken in the order named. The Dutch prouss comprises the following aparation. 1st. Cashing the lead in required form. 2ud. Building the beds. 3 rd. Laking the beds apart. 4 the. Picking up. 5th. Grinding + C. The fifth apiration will be described in detail for all methods. The picking up is also dispused with in modur

Holland and England and became known as the "Dutch method." There are a great many methods employed in the manufacture of white lead, but only the most important of these will be described in detail. These are three in number 1st "The Dutch"; 2nd "The English"; 3rd "The French"; taken in the order named. The Dutch process comprises the following operation. 1st. Casting the lead in required form 2nd. Building the beds. 3rd. Taking the beds apart. 4th. Picking up.

(8)

5th. Grinding &c. The fifth operation will be described in detail for all the methods. The picking up is also dispensed with in modern

works. I Casting the lead - had is welled in ket tiles cound with hoods to protect the workmen from funes, which are dauger ous, especially when old hads are tring multid. When had is melted it is cost one a large irou flate and when enough has solidified the leadout of is necof, leaving a this shat about sixty centimeters long, tu centimetres wide, and a fur millimetus Thick which weighs about one kitogran. These shuts are cut into and solled inte spirils, for the pots. These operations present very little dauger to the workun. I Building the beds. - Bids are built of store or brick. Thy are about one wet deep in Fryound. Thirdimensions are fire metrolong four wide, and six high.

(9)

works.

I Casting the lead. -- Lead is smelted in kettles covered with hoods to protect the workmen from fumes, which are dangerous, especially when old leads are being smelted. When lead is smelted it is cast on a large ironplate and when enough has solidified the lead on top is run of, leaving a thin sheet about sixty centimetres long, ten centimetres wide, and a few millimetres thick, which weighs about one kilogram. These sheets are cut in two and rolled into spirels, for the pots. These operations present very little danger to the workmen.

II Building the beds. -- Beds are built of Stone, or brick. They are about one metre deep in the ground. Their dimensions are five metres long, four wide, and six high.

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(10)

Stable manner of spirit tare are usedie the beds. Where stable manue is used for ation nquins any forty days, while with spirit tare, it requires sixty to remety days. Alayer, Thirty centimeters wide and forty high. is built oround the bed with ald Manue, The space is Thereliveled up with fish manuse on which the pots not. Each layer contains 1200 pots each filled, with about a fourth of a lite of vinegar, up to the two knows an which the spinel of lead nots. This is cound with lead shuts and the with scartlings. Room is left between Thise stantlings for draft, which a thur cound with boards. Ou These boards another similar layer is built, until bed is filled. Anamage bed nounes-1. 8 two-horse loado of stable manner; 2.800 litro of viregar per layer or 2400 purbed;

Stable manure, or spent tan are used in the beds. Where stable manure is used operation requires only forty days, while with spent tan, it requires sixty to ninety days. A layer, thirty centimetres wide and forty high, is built around the bed with old manure, the span is then leveled up with fresh manure over which the pots rest. Each layer contains over 1200 pots each filled, with about a fourth of a litre of vinegar, up to the two knobs on which the spirel of lead rests. This is covered with lead sheets and then with scantlings. Room is left between these scantlings for draft, which are then covered with boards. On these boards another, similar, layer is built, until bed is filled. An average bed requires --

- 1. 8 two-horse loads of stable manure;

(10)

2. 800 litres of vinegar per layer or 2400 per bed;

(11)

3. 1200 to 1500 kilograms of lead per layer, or from 10,000 to 12,000 kilo grans per bed. Four men ean build a bedie four days: That is, a bed requires six time days work. There is no dauger in building these beds. III Laking the beds apart. - The beds are takes apart in the following manner: The manner, boards scartlings of the top layer moved . The conoded lead is put into abox. when the largest pieces of non corroded metalare mared. The working say that the is little dauger in this work; isfridly if they are allowed to subte In some works the noncorroded metal is mu-Ited but in athus it is used to cover thipots. 12,000 kgr. had give - corborated lead 10000 kgr. nou enrodedlad 400 kgr. The minare in wight is the for about \$ 5%. Slow may be used in taking beds apart, but one very unharedy.

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3. 1200 to 1500 kilograms of lead per layer, or from 10,000 to 12,000 kilograms per bed. Four men can build a bed in four days: that is, a bed requires sixteen days work. There is no danger in building these beds III Taking the beds apart. -- The beds are taken apart in the following manner: The manure, boards, scantlings, of the top layer removed. The corroded lead is put into a box where the longest pieces of noncorroded metal are removed. The workmen say that there is little danger in this work; especially if they are allowed to smoke. In some works the noncorroded metal is smelted but in others it is used to cover the pots. 12,000kgr. lead give -- carbonated lead 10000 Kgr. noncorroded lead 400 kgr. The increase in weight is there for about 25%. Gloves may be used in taking beds apart, but are very unhandy.

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(12) The Eight withod differs from the Dutch in using spent taxin shadd manuse, Thurly lessering the liability of desedor-Ation by sulphurched hydrogen; but The use of Law lengtheus the time massary for production of white lead. Pyroliqueous acid is sometimus used inshad of villegar. The lead used should be of the purchased softest kind, manufacturers routines punify the lead Themselves. Copper and and imony produce a whitehad which is grigishinedor. it ud or puck coloration is athibut the presence of a suboxide of lead. Lead is cart into this grahs, so as to expose as large a surfuce as possible to The action of The vapors of auticaid, carbon dioxide, and water, by froming The mother metal area sloping grooved iron plate, from which They are easily

(12)

The English method differs from the Dutch in using spent tan instead of manure, thereby lessening the liability of discoloration by sulphureted hydrogen; but the use of tan lengthens the time necessary for production of white lead. Pyroligneous acid is sometimes used instead of vinegar. The lead should be of the purest and softest kind. Manufacturers sometimes purify the lead themselves. Copper and antimony produce a white lead which is greyish in color. A red or pink coloration is attributed to the presence of a suboxide of lead. Lead is cast into thin plates [grates?], so as to expose as large a surface as possible to the action of the vapors of acetic acid, carbon dioxide, and water, by pouring the molten metal on a sloping grooved iron plate, from which they are easily

detached. There are sometimes madely maching. The machine consists of are endless chain of iron plats, each plate being a mold, into which the lead is pound as the molds pars in succession beneath the sport of The lead kettle The castings are delivered auto a leather belt evend with shul irow. This machine makes from fifty to sixty cartingsin ou minute. The conosion is effected il stacks, which are built in brick work chaulon, They are usually high side by side along The side of a shide ... The dimensions of These chambers are verable, being from twelve by tovaty fuch, to six ture fectigueare, and about twenty fire fut in hight. The front wall has an opening fourful wide nuning four top to batton, and is used in building up the stack

(13)

detached. These are sometimes made by machinery. The machine consists of an endless chain of iron plates, each plate being a mold, into which the lead is poured as the molds pass in succession beneath the spout of the lead kettle. The castings are delivered onto a leather belt covered with sheet iron. This machine makes from fifty to sixty castings in one minute. The corrosion is effected in stacks, which are built in brick work chambers. They are usually built side by side along the side of a shed. The dimensions of these chambers are variable, being from twelve by twenty feet, to sixteen feet square, and about twenty five feet in height. The front wall has an opening four feet wide running from top to bottom, and is used in building up the stack

The opening being closed with boards as the stack now in hight In building a stack the floor is first cound with ashes, ou this is sprad a layer of ferneutry tare to a hight of about three feet, which is tamped down and surface leveled. The pots, which are port ially filled with deluch auticaid, about Two to the present, are now placed on the tare. Thy are pland close to gether leaving about six uches between the last now of pops and the walls. Two siges of pots are used; a large size with a projuting ning an The inside upon which a This disc glead nots; which serve to support The boards cour ing the middle pats. Che top of the pots an filed lead cratis to a depth of fire inches; between the had and the coving of flooring boards a space of six or eightinches is left. The space between The walls and

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The opening being closed with boards as the stack rises in height. In building a stack the floor is first covered with ashes, on this is spread a layer of fermenting tan, to a height of about three feet, which is tamped down and surface leveled. The pots, which are partially filled with dilute acetate acid, about two to three percent, are now placed on the tan. They are placed close together leaving about six inches between the last row of pots and the walls. Two sizes of pots are used; a large size with a projecting ring on the inside, upon which a thin disc of lead rests; which serve to support the boards covering the middle pots. On the top of the pots are piled lead crates to a depth of five inches; between the lead and the covering of flooring boards a space of six or eight inches is left. The space between the walls and

pots is filled with tan Another bed is built on this in the same way except that the tan is only about one inch in Thickness. The slacks are built up about twenty fut and there or end with tax. Tha stack twelve by twenty fut abed contains twelve town of leading our thousand pots, fire and our halfurches ice diarrehr, containing two hundred gallous of dilute activacid. The opening at the top is left miclored for examination. In large stack ventilation is regund which is accomplished by placing wooden apouts in the concers of the stack. Stack is now lift about the months. The temp-Aure some turns vising to 48.5°C, at which Temptun auticarid, water, and also corbon digide on evolved which gadual attack the lead transforming it into white lead. At the end of three mouths

(15)

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pots is filled with tan. Another bed is built on this in the same way except that the tan is only about one inch in thickness. The stacks are built up about twenty feet and then covered with tan. In a stack twelve by twenty feet a bed contains twelve tons of lead in one thousand pots, five and one half inches in diameter, containing two hundred gallons of dilute acetic acid. The opening at the top is left unclosed for examination. In large stack ventilation is required which is accomplished by placing wooden spouts in the corners of the stack. Stack is now left about three months. The temperature sometimes rising to 42.5 °C, at which temperature acetic acid, water, and also carbon dioxide are evolved, which gradually attack the lead transforming it into white lead. At the end of three months

the stack is unloaded. The top tar is me and and that which is not mouldy is put with the fish tay to be used again. The orats are loaded into Trays and comid to thruild in which the white lead is reparabed from The nor consider utal. The cratismtain This shape, but are gratly increased in bulk, and have a white apaque appearand. The best consider an Those nsurbling portian in appearance. Some times the lead is discolored which discoloration may be due to Farry Mather, prient in the acid, or by the dripping of water from the tare. Before muovaliach layer, as it is exposed, is thoroughly mais-Tend with wahr. White lead Taker direct from stack is not uniformin composition. It consists mainly of 8 Pb Elg. Pb (HO)2. Allemosious Cautain

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the stack is unloaded. The top tan is removed and that which is not mouldy is put with the fresh tan, to be used again. The crates are loaded into trays and carried to the mill in which the white lead is separated from the non corroded metal. The crates retain their shape, but are greatly increased in bulk, and have a white opaque appearance. The best corrosions are those resembling porcelain in appearance. Sometimes the lead is discolored which discoloration may be due to tany matter present in the acid, or by the dripping of water from the tan. Before removal each layer, as it is exposed, is thoroughly moistened with water. White lead taken direct from stack is not uniform in composition. It consists mainly of 2 PbCO₃ . Pb(HO)₂. All corrosions contain

(7) lead actate which is washed out, The pots are usually found empty and dry. They are washed dried and used again Pieces of white lead which fallauthe tan are picked up, and tall is raked to secure any further quantity of white had that they contain. The Consions an uext separated from the noncorroded metal and ground. The unthods of grinding and washing vary in different works. The cratis are usually suck in a cistion of water and pushed with a rake between comgated rollers muningunder a straw of water. This method obridtes dust which is very porsonous. The white lead is the crushed, by possing through a pair of smooth gui metal rolling, and raked about our a perforated

(17)

lead acetate which is washed out. The pots are usually found empty and dry. They are washed, dried, and used again Pieces of white lead which fall on the tan are picked up, and tan is raked to secure any further quantity of white lead that they contain. The corrosions are next separated from the non corroded metal and ground. The methods of grinding and washing vary in different works. The crates are usually sunk in a cistern of water and pushed with a rake between corrugated rollers running under a stream of water. This method obviates dust which is very poisonous. The white lead is then crushed, by passing through a pair of smooth gun metal rollers, and raked about over a perforated

plate under a constant spray quater. The crane white lead is passed are to a grinding stare which is fed by handor by an endliss belt, after passing that gh These starres The white lead has The appearance of a Thick white und, and is aground mutil it is so fine that it may be camid along by a strain of water to The settling tanks; The lead which settles in the troughs leading to The settling Tauks is nground. The grinding and washing are canduct ed in such a way that the sauce water may be used our again. This water gunrally contains had salts in solution which are precipitated by sodium carbonate. In the tanks The white had gradually sittles to the bottom and the water's

(18)

plate under a constant spray of water. The coarse white lead is passed on to a grinding stone which is fed by hand or by an endless belt. After passing through these stones the white lead has the appearance of a thick white mud, and is reground until it is so fine that it may be carried along by a stream of water to the settling tanks; the lead which settles in the troughs leading to the settling tanks is reground. The grinding and washing are conducted in such a way that the same water may be used over again. This water generally contains lead salts in solution which are precipitated by sodium carbonate. In the tanks the white lead gradually settles to the bottom and the water is

sphoud off. When thrund is Thick enough it is ladled out into drying dish is. There dishes one of clay twelve ind is in drauth and the uches dup. The deshis are The stacked on ivou shilves in dry ang stoves which are heated by pipes to save garound The bottom course many with a grate outside of the store. Theredeout Tains 25 to 30 percent water This is dud the tup unrexending 68°C. The white lead when dry is taken from the stores and packed il carks or ground in ail, Boiled lused oil is used, from ught to unde pounds for eny one hundred founds of white had, During grunding some manufactums add a small amount of Prossareblue

(19)

siphoned off. When the mud is thick enough it is ladled out into drying dishes. These dishes are of clay twelve inches in diameter and three inches deep. The dishes are then stacked on iron shelves in drying stoves which are heated by pipes passing around the bottom, connecting with a grate outside of the stove. The mud contains 25 to 30 per cent water this is dried the temp never exceeding 68°C. The white lead when dry is taken from the stoves and packed in casks or ground in oil. Boiled linseed oil is used, from eight to nine pounds for every one hundred pounds of white lead. During grinding some manufacturers add a small amount of Prussian blue

(20) or indigo to modify the yellow Tent due to stains from the tax. Another English wethod is as fallows;-Lad is melhdin a large irou pot and wade to flow ou to the hearth of a newbratay fur-Mace, so as to convert The lead into oxide. This is obtained in a findy divided state lythe fallowing awan gunent of fundad. The hearth of The furnace has a gutter into which the molter mars flows, The rides of The get-In being perforated, so that The motion lithunge flows out, while the head sinks to the bottom. The litharge is mixed with To part of its wight of a solution of lead autate, and placed in a series of closed toughs, communicating with each other and admiting of the passage of pure carbon dioxide, oblained four burning coak in a furnare provided with a blast.

(20)

or indigo to modify the yellow tint due to stains from the tan. Another English method is as follows;--Lead is melted in a large iron pot and made to flow on to the hearth of a reverberatory furnace, so as to convert the lead into oxide. This is obtained in a finely divided state by the following arrangement of furnace. The hearth of the furnace has a gutter into which the molten mass flows, the sides of the gutter being perforated, so that the molten litharge flows out, while the lead sinks to the bottom. The litharge is mixed with 1/100 part of its weight of a solution of lead acetate, and placed in a series of closed troughs, communicating with each other and admitting of the passage of pure carbon dioxide, obtained from burning coak in a furnace provided with a blast.

(21) The mixture is stind by Machineryto auchate the absorbtion of the gas. The white lead made by This method ions well and is profesed to that made by the wet av, Franch Method," which is as follows: If a solution of basic lead acetate Letma-Led with earbour dioxide, faart of the oxide of lead in the salt is convented into conbou ate, and the mainder becomes untral autate. By adding a new profontion of lithouge to the intral asetate, it becomes basic again by solution of litharge, making the forouss contineous. A solution of basic had aretate of forofis strugth, is made as follows; foist, foil a solution of unbalantate with ony finly divided letharge. When The litharge has dissolved and abasic solution well

(21)

The mixture is stirred by machinery to accelerate the absorption of the gas. The white lead made by this method covers well and is prefered to that made by the wet, or "French Method," which is as follows: If a solution of basic lead acetate be treated with carbon dioxide, part of the oxide of lead in the salt is converted into carbonate, and the remainder becomes neutral acetate. By adding a new proportion of litharge to the neutral acetate, it becomes basic again by solution of litharge, making the process continuous. A solution of lead acetate, of proper strength, is made as follows; First, boil a solution of neutral acetate with very finely divided litharge. When the litharge has dissolved, and a basic solution is well

(22)

saturated, The liquor is drown of from The neidres into a closed versel. There Carbon dioxide is introduced, which is made by the combustion of coak, and and should be well washed, do soon as The basic excess of lithorge has been traces found into carbonate The liquorson allowed to settle. The white lead falls to the bottom, and the neutral autate is drawn off and boiled with litharge to four bosin autote again. Thur is a anall accidental loss f Heuntral aretate. The white lead is washunted very clean, the first work waters being ntuned to the untral autote solution and dried in pots in a store room. This white lead's are impalpable powder, as white as snow, but has liso density and body Than white

saturated, the liquor is drawn off from the residues into a closed vessel. Then carbon dioxide is introduced, which is made by the combustion of coak, and should be well washed. As soon as the basic excess of litharge has been transformed into carbonate, the liquors are allowed to settle. The white lead falls to the bottom, and the neutral acetate is drawn off and boiled with litharge to form basic acetate again. There is a small accidental loss of the neutral acetate. The white lead is wash until very clean, the first wash waters being returned to the neutral acetate solution, and dried in pots in a store room. This white lead is an impalpable powder, as white as snow, but has less density and body than white

(22)

(23) lead made by the Dutch and Eighik formessio. The theory of These processo, as well as of many others, is as follows :-1. The formation of basic acetate. 2. The decomposition of basic acetate into neutral and white lead. This is illustrated in the following formwhere $I. = \begin{cases} c_2 (+30) \\ H \\ \end{pmatrix} + 3 p_{6-0} = \begin{cases} c_2 (+30) \\ p_6 \\ \end{cases} \\ 0_{23} 2 p_6 (+10) \\ 2 \\ 2 \\ \end{pmatrix}$ Autuaria Basicleadacetate F. {(21/30/2] 02, P6(1)(2)2 + 202 = 3PbC03 + P6 } 02, P6(1)(2)2 + 202 = 3PbC03 + Lead carborat Basic lead acilate 2 (C2(+30)2)02. mumilleadautate

(23)

lead made by the "Dutch" and "English" processes.

The theory of these processes, as well as of many others, is as follows:-- The formation of basic acetate. 2. The decomposition of basic acetate into neutral and white lead. This is illustrated in the following formulae

I. 2 { C_2H_3O } +3PbO= { H} Acetic acid

II. $\{(C_2H_3O)_2\}O_2, Pb(HO)_2 + 2CO_2$ $2Pb(CO)_{3} +$ Pb} Lead carbonate **Basic lead acilate** $\{(C_2H_3O)_2\}O_2$ Pb} Neutral lead acetate

 $\{(C_2H_3O)_2\}O_2, 2Pb(HO)_2\}$ Pb} **Basic lead acetate**

(24) This shown, by this, that a small quawhity of lead acetate conforduce large quantity of white lead and that The formers would be endliss but that the white lead sitains some untralaceter. and the loss of auticaried connot be avoided. Adulturation of white lead is still prachied to some extent, generally by adding barine sulphate, ethin watwalor artificial. White lead is also sometimes mixed with lead sulphate chalk, barne carbonate, and pipeday, which have no caving power tabout oil causing a worth of this article. Pure white lead aught to be solwhe in dilute intriacid in which Solution KOH should not produce aprice pitate. Ansidue andissolvingin

(24)

It is shown, by this, that a small quantity of lead acetate can produce a large quantity of white lead, and that the process would be endless but that the white lead retains some neutral acetate, and the loss of acetic acid cannot be avoided.

Adulteration of white lead is still practiced to some extent, generally by adding barium sulphate, either natural or artificial. White lead is also sometimes mixed with lead sulphate, chalk, barium carbonate, and pipe clay, which have no covering power & absorb oil causing a waste of this article. Pure white lead ought to be soluble in dilute nitric acid, in which Solution KOH should not produce a precipitate. A residue on dissolving in

(25) withis and indicates the forserved gyfsun, heavy spar, or lead sulphate. Lud sulphat could detected with the blowpipe. Barine sulphate may be detected by equit ing on charood, trating noide with Hydrochloric and adding a solution of gypsum which again for pitatithe baring sulphate. Sypsun does not have a nsidue with within and but may be pripitated with annound oxalan. To more the ail throng by the into the paint a mixtun fequal farts of chloroformand alcohol and work and film with anithing & portsof chloroform and 1 falcohol, The quant ity of airlis ascartained y waporating This mixture . Wash Twice with oil ing water and dry, after which the had may be Lestiet yusual muthods

(25)

nitric acid indicates the presence of gypsum, heavy spar, or lead sulphate. Lead sulphate could be detected with the blowpipe. Barium sulphate may be detected by igniting on charcoal, treating residue with Hydrochloric acid, and adding a solution of gypsum which again precipitates the barium sulphate. Gypsum does not leave a residue with nitric acid but may be precipitated with ammonium oxalate. To remove the oil, thoroughly stir into the paint a mixture of equal parts of chloroform and alcohol, and work on a filter with a mixture of 2 parts of chloroform and 1 of alcohol. The quantity of acid is ascertained by evaporating this mixture. Wash twice with boiling water and dry, after which the lead may be tested by usual methods

(36)

Finding white head, with courieration of the effects of dust ou the work-

mer.

Owing to the poison ous effect of the dust forodured in grinding white had, upon the health of the workingergaged their, many machines have bau mouted to prevent dust. Our effective machine is known as The Ward machine. This comprises: -I. A Trough, 4 metris long, 2 metris wide, and 1.3 methodiep. I. Two brars rollins, superfrond, for grinding the substances. The low one is incursed in water, so that This ling contact is under water . motion is imported to the upper volter by a pulley, and Thursto lown ly pinions. Counter weights an fixed to the

(26)

Grinding white lead, with consideration of the effects of dust on the workmen. Owing to the poisonous effect of the dust produced in grinding white lead, upon the health of the workmen engaged therein, many machines have been invented to prevent dust. One effective machine is known as the Ward machine. This comprises:--I. A trough, 4 metres long, 2 metres wide, and 1.3 meters deep. II. Two brass rollers, superposed, for grinding the substances. The lower one is immersed in water, so that their line of contact is under water. Motion is imparted to the upper roller by a pulley, and thence to lower by pinions. Counter weights are fixed to the

(37) uppen oxis to proved dogging where Too large a pure of had is introduced. II A perforated oak platform, holes 15 or 16 millimetus in draueter. serving as a sieve for the material which leaves the rolls, This platfour is held & autimetres below the sollo, by wooder block abore and below it. IV An in chine for fuding the vollers. An outlet is lift anow side of the Frough for water. The white lead fue ly powdered falls Through the holes in the platform, while the laurica-Fed rulad staysautop and is solved off. do The whitelead and non conoched metal are separated intirely under water, no dougerous dustiscapes.

(27)

upper axis to prevent clogging where too large a piece of lead is introduced. III A perforated oak platform, holes 15 or 16 millimetres in diameter serving as a sieve for the material which leaves the rolls. This platform is held, 8 centimetres below the rolls, by wooden block above and below it.

IV An inclined plane for feeding the rollers.

An outlet is left on one side of the trough for water. The white lead finely powdered falls through the holes in the platform, while the laminated metal always stays on top and is raked off.

As the white lead and non corroded metal are separated entirely under water, no dangerous dust escapes.

(88)

The metallic platos an allowed to drain an in clind trough be for multing. Then any the nasous that the substands are not withed before possing

Through the rolls. 1. They would be composty and This Jossaye Though the solls diffi

cult. 2. This poste would not a will sight. 8. Acertain proportion quitallie lead is mursary to the aperation and should not be minored be forthe

substances are porsed through

The rolls.

(28)

The metallic plates are allowed to drain an inclined trough before smelting.

There are three reasons that the substances are not [netted?] before passing through the rolls.

- They would be composty, and 1.
- 2.
- 3. substances are poured through the rolls.

their passage through the rolls difficult. This poste would not be well sifted. A certain proportion of metallic lead is necessary to the operation, and should not be removed before the

(29) In Southwest missouri a socalled white had is made by collecting the funes from the swelting of golund in or hearths, but differs very wuch meouposition from other white leads. There two apartions involved first, cooling and collecting of darkare hearth funes called blue powder, in the first bay house, on blue room; second, nfiring blue powder in a slaggy efollowed by cooling and colluting of white paint in the second bag room or fraint hour The funer from the on hearthou drown off lya suction farrix fit in dianet, Thufat wide muning at 270 molutions provinte. They are first drown through a dust chamber of buck four fut long

(29)

In Southwest Missouri a so called white lead is made by collecting the fumes from the smelting of galena in ore hearths, but differs very much in composition from other white leads.

There are two operations involved: first, cooling and collecting of dark ore hearth fumes, called blue powder, in the first bag house, or blue room; second, refining blue powder in a slag eye followed by cooling and collecting of white paint in the second bag room or paint house. The fumes from the ore hearth are drawn off by a suction fan six feet in diameter, three feet wide, running at 290 revolutions per minute. They are first drawn through a dust chamber of brick four feet long,

(80)

minuten fut high and six and our holf feet wide. This catches the herry porticles. The dust passes out at the top of the chamber by a five fost pipe of shut iron 300 fut long to a four and Theme , Through a four foot pipe to The blue rour. This room is built of brick, 95 feet long, o wide and 45 fut high . It is in two comportments, so That are may be shut when it is neversary to examine the bags. Each of these compartments is in two stories, The lower 12 feet high. The four fort pipe is divided into four branches in each now, compouding to four mus of nine hoppers each. Thise on 12 feet wide at The top, and 1.5 at Heberrow, and one 10 but high, the hoppen ever is made of 1/6 inch shut wor with sixtue holes 18 in in deant-

(30)

nineteen feet high and six and one half feet wide. This catches the heavy particles. The dust passes out at the top of the chamber by a five foot pipe of sheet iron 350 feet long, to a fan and thence through a four foot pipe to the blue room. This room is built of brick, 95 feet long, 50 wide and 45 feet high. It is in two compartments, so that one may be shut when it is necessary to examine the bags. Each of these compartments is in two stories, the lower 12 feet high. The four foot pipe is divided into four branches in each room, corresponding to four rows of nine hoppers each. These are 12 feet wide at the top and 1.5 at the bottom, and are 10 feet high. The hopper cover is made of 1/16 inch sheet iron with sixteen holes 18 in in diameter,

31 the with Thimbles Buches long prog etting upwards. To these on End we washed woolur bago somehis indianeeta and 33 fit long. Thuppenerds of the bago on Fud shut and an sus purded from rods of gos pipe, Then oar 800 bags in are house. The gariour-Loing the hoppus and bays, underlow forsure, ore filtered. The hoppers, which serve to collect The funes, an counted to gether hy short lengths foipe. The bags on shaken every two days. The composition of the blue power in the hoppus rois as the distance of The hopping from the furnace us mases. Diminition in amounts & Faroz, Mroz, Cao, Sioz, Cor, and Soz, being particularly noticable.

with thimbles 12 inches long projecting upwards. To these are tied unwashed woolen bags 20 inches in diameter and 33 feet long. The upper ends of the bags are tied shut and are suspended from rods of gas pipe. There are 800 bags in one house. The gases entering the hoppers and bags, under low pressure, are filtered. The hoppers, which serve to collect the fumes, are connected together by short lengths of pipe. The bags are shaken every two days. The composition of the blue powder in the hoppers varies as the distance of the hopper from the furnace increases. Diminution in amounts of Fe_2O_3 , AI_2O_3 , CaO, SiO₂, CO₂, and SO₂, being particularly noticeable.

(31)

(32) The blue founder is mixed with washe oil and wasteand find. It burns about tur hours liberating heat and 802, leaving a porous pink nsidue which is guite friable, and is four from carbonaceous mather and lead culphide. It's now nfined in the slag eye. As The abjut of this process is to produce as much oxide as possible, very little lead is produced. Charge Blue proder - - - - - - 1000 # Dyboue (corbonate) - - - - 600# Dust from Cooling Chamber + pipes 4 50 # With The ore also mixed tin scrop and coak. The satio & lead to paul fordund is 1716. It is murray to keep a hot top and a vuy liquid slag In starting the product for the first

(32)

The blue powder is mixed with waste oil and waste and fired. It burns about ten hours liberating heat and SO₂, leaving a porous pink residue, which is quite friable, and is free from carbonaceous matter and lead sulphide. It is now refined in the slag eye. As the object of this process is to produce as much oxide as possible, very little lead is produced.

<u>Charge</u>

Slag -----2800# Blue powder -----2800# Dry bone (carbonate) -----600# Dust from cooling chamber & pipes-----600# With these are also mixed tin scrap and coak. The ratio of lead to paint produced is 1 ÷ 1.6. It is necessary to keep a hot top and a very liquid slag. In starting the product for the first

33.

five hours is blue foorder and good paint is not made until fumare has muabout Liventy four hours. The paint ferres are drawn from The funcie by a fair, as before, first through a server foot pipe, 85 ft vertically downward the into about chamber 95 g fut in area, there upwards & ofut Thougha B's foot pipe curving downwards to a second trick chanter 75 29 fut in and, and in the some manunit postes through a Third and fourth chambers. The firms the poro to the cooling room or second bag room This is 40 × 90 fut, built in two stories 9 ft. high. It is similar in all ather nobuts to the first bay room except that The hoppus are made f wood lind with shut iron, blow which

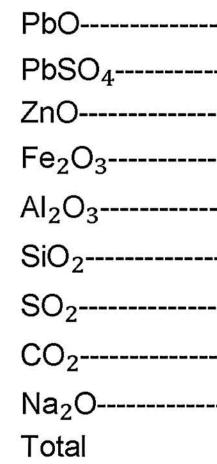
(33)

five hours is blue powder and good paint is not made until furnace has run about twenty four hours. The paint fumes are drawn from the furnace by a fan, as before, first through a seven foot pipe, 25 ft vertically downward then into a brick chamber 95 sq. feet in area, thence upwards 20 feet through a 3 ¹/₂ foot pipe curving downwards to a second brick chamber 75 sq feet in area, and in the same manner it passes through a third and fourth chambers. The fumes then pass to the cooling room or second bag room. This is 40 x 90 feet, built in two stories 9 ft. high. It is similar in all other respects to the first bag room, except that the hoppers are made of wood lined with sheet iron, below which

(34) on woodure bius abolined with iron The following analysis gives the may composition of the paint Pto ---- 8 5.85 P6504 ---- 65.46 Tuo ---- 5.95 FerOs ----- 0.03 Sila ---- 0.10 to Frace 502 --- -- 0.04 CO2 - - - - - - 1.53 Na20 - - - - - - 1.69 Istal 100.67 The give oxide contained in This paint rather inforoves its quality Thanather wise, because it provents the paint being blackered by sulphinsted hydrogen.

(34)

are wooden bins also lined with iron. The following analysis gives the average composition of the paint produced by this process.



The zinc oxide contained in this paint rather improves its quality than otherwise, because it prevents the paint being blackened by sulphuretted hydrogen.

25.85
65.46
5.95
0.03
0.02
0.10 to trace
0.04
1.53
<u>1.69</u>
100.67
ned in this paint