國立交通大學研究所

化學組

油漆試驗報告

專刊

化學類第三號

上海

中華民國二十五年

存

研究所化學組油漆試驗報告

目　　錄

研究所化學組本年度經過概況

徐　名　材

本校研究所化學組成立已逾六年。一方面從事分析檢驗工作，聊盡服務社會之天職。一方面研究油漆製造問題，冀達促進學術之志願。近一年來，繼續未停，用述概況，藉作報告。

(一)代辦事項　本年度接受外界委託事項，計有三十餘件；以煤，水爲較多，此外有礦砂，合金，硫酸，滑油石墨，汽油等項。茲列表於後，以見梗概：

號數	品物	委託人	樣品數目	樣品來源	報告單號數
1	煤	新通貿易公司	一	開平	一九二
2	錳粉	合衆電氣公司	三	湖南	一九三
3	河水	上海交通公司	一	黃浦江	一九四
4	汽油沉澱	航空委員會	一	未詳	一九五
5	煤	隴海鐵路局	四	井陘正豐煤礦	一九六
6	井水	南潯鐵路局	一	南昌南泵房	一九七
7	煤	正太鐵路局	一	山西太原西北煤礦	一九八
8	人造汽油	浙江建設廳	一	杭州民生廠	一九九
9	汽缸油	南潯鐵路局	二	美孚，德士古	二〇〇
10	石墨	范樂山先生	一	浙江	二〇一
11	煤	隴海鐵路局	一	山西鄉寧	二〇二
12	河水	新通貿易公司	一	無錫	二〇三
13	水泥	隴海鐵路局	一	西北實業公司	二〇四

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14	井水	南潯鐵路局	一	南昌南泵房	二〇五
15	合金	中興煤礦公司	一	未詳	二〇六
16	煤	上海市公用局	二	未詳	二〇七
17	滑油	中華聯合工程會計事務所	三	亞細亞,孔士	二〇八
18	硫酸	交通部上海電話局	三	江蘇藥水廠	二〇九
19	鐵砂	張國瑞先生	一	浙江湖州	二一〇
20	軸油	正太鐵路局	三	未詳	二一一
21	煤	隴海鐵路局	一	宜陽煤礦	二一二
22	煤	隴海鐵路局	二	未詳	二一三
23	江水	江南鐵路公司	一	蕪湖江水	二一四
24	硫酸	交通部上海電話局	五	未詳	二一五
25	鉛礦	隴海鐵路局	一	未詳	二一六
26	河水	浦東電氣公司	二	黃浦江	二一七
27	鑄鋼	鐵道部購料委員會	二	未詳	二一八
28	煤	柏連坡煤礦公司	一	河南安陽	二一九
29	井水	隴海鐵路局	二	未詳	二二〇
30	煤	中華聯合工程會計事務所	一	安徽宣城	二二一
31	水	隴海鐵路局	二	老窰墟溝	二二二

(二)研究問題 本年度繼續進行研究問題,有(一)蓖麻子油製成乾性油之研究,(二)油溶性人造樹脂之研究,(三)桐油酸製合成油之研究,均爲油漆業重要問題。近年來各國人士注意研究者亦漸多結果多未公布,本組經數年試驗,已告一相當段落。本年度開始研究問題,有(一)羣青之試製,(二)青油作桐油代用品之研究,(三)蓖麻油製潤滑油之研究,(四)豆酪製水粉漆之研究,亦已得相當結果另有豆酪提煉一題,經化學系同人研究多年,茲亦擇要發表。此外學生論文工作,與油漆問題有關者,尚有生漆之研究,及什醇油中提煉溶劑之研究等。試驗結果,均詳研究報告中。

(三)添置設備 近來限於經費,對於試驗設備,未能儘量添置。

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本年度新購者,計有石盤磨一具,三輥磨一具,以供少量試驗之用。另由化學系購硬度檢定器一具,價值千餘元,頗精密合用。目前急待需用,而無力購置者,有顯微照相器,以及乾率光度黏度檢驗器等件。

(四)工作人員 本組工作人員,多由化學系同人兼任。本年度担任分析工作者,爲謝惠袁積誠陳兆畦朱自立諸君;現陳君改就上海水泥廠職務,朱君改派他項工作,另聘萬葆德蔣孫穀二君繼任。油漆試驗方面,仍由沈慈輝君担任指導,分任研究者,有韋鏡權任通寶梁榮光諸君。

(五)試製儀器 油漆試驗器械需費頗鉅,普通試驗室不能購備,茲擬先就最重要之比色計黏度計二項,計劃試製簡便儀器,以供製造及利用油漆者之採用,似亦本所應盡之責任。現在技術上困難問題,均已解決,下年度即可入手製造。

(六)審訂標準 油漆種類繁多,功用互異,品質高下,相去倍蓰,採用者每以選擇爲苦。吾國各鐵路及其他機關,對購買規範,尚未訂定,似有從速草擬之必要。本組擬參酌海外實用規程,考慮國內商業狀況,擬定一公允適用之標準,以供各界之參考,正在入手籌備中。

本組試驗結果,前已刊行報告兩期,茲復就年來研究所得,益以公餘撰述,彙集付梓。同人等課暇旁及,能力有限,設備多缺,補充無從,經年累月,愧鮮宏效。以視英國泰定頓油漆試驗所,成立不及十年,兩次擴充,已完成一偉大之研究機關者,望塵莫及,良深惶悚。第以油脂多吾國特產,塗漆尤建設必需,國計民生,不無關係,同人探求有年,不敢暇逸,勉効千慮一得之愚,冀獲銖積寸累之功。尚希海內明哲,予以贊助,時賜指教,俾作南針,尤同人所企禱也。

油漆試驗室下年度工作計劃

沈　慈　煇

下年度工作計劃,仍擬注重油漆問題,一方面就原有各題,繼續研求,一方面選急要工作,入手進行。茲將擬定計劃,撮述如下:

(一)油漆之抗鹼性能

油漆之用於鹼性物面,最易皂化,所以石灰或水泥之建築物塗漆之後,往往初則變色,日久漸漸剝落,永無耐久性能,如塗刷於其他物面者,此乃人所共見,亦無法制止之。然市售各種水泥漆,名稱雖異,實際上皆爲普通油漆之一種,而無耐久能力。本題擬根據各種學說試驗,並於物質上力求改良,使耐久不變,且於製造上合於經濟原則。

(二)防銹漆擴大試驗

本題已於二十三年擇要試驗,成績尚佳,所得結果,已見第二號報告。更擬擴大試驗,以收成效,乃因工作人員不敷分配,未得按照計劃進行試驗。本學期仍應繼續工作,並將加製數份,送交鐵路當局試用,以覘試驗室與實地試驗結果之比較情形。

(三)從桐子餅提取桐油之試驗

桐油之用途漸廣,銷數亦增,是以供不應求,而致油價劇漲。但不知土法提油,終不能如機榨之純淨,且產量亦少。以每噸少提十分之一計算,則每年損失,幾及一二千萬元。按現在我國狀況,全國設立機製油廠,一時尚難實現,而每年幾千萬元之桐油,棄若糟粕,殊爲可惜。本題擬將桐餅設法提取餘油,以觀其成分及品質,所剩

殘渣,仍可供肥料之用,或有供飼料之價值,亦應逐一分別研究。

(四)蓖麻子油製成乾性油之研究

上年度曾將提煉之淨蓖麻子油,在普通氣壓蒸溜,得類似桐油之淡色乾性油,見第三號報告。以後試驗程序,仍按步進行,在蒸溜之過程中,擇定數點,取出油樣,加以詳細分析,以研究其化學組織之變化。

(五)羣青之試製

據上年在小電爐中試驗之結果,煅燒情形,及原料成分與色彩之相互關係,大致已可明瞭,見研究報告中。本年仍擬繼續原定方針,與半工業化之試驗,同時進行。前之試驗未週者,將加以補充,所得成品,均將詳細分析,並測驗其性能,以資比較。

(六)全國鐵路應用標準油漆及漆法之商榷

本題擬參考歐美各國鐵路用漆之標準,及現在各路採用油漆之種種困難問題,試行草擬各種標準油漆及漆法,使經濟而適合用途。

(七)油溶性人造樹脂之研究——曝露試驗

油溶性人造樹脂之研究,上年已將製造及性質兩部完成,唯其耐久性及施用後之變色與否,尚有待於探討。茲將製成之各種樹脂,用其純體及與亞麻子油配成之漆,製成樣片,於人工曝露機及天然曝露之下,分別進行曝露試驗,以完成對於人造油溶性樹脂之全部研究。

(八)蓖蔴子油經高壓加熱及接觸劑後性質變化之研究

此項研究,近年德法日等國,均分別舉行,各就其環境而從事研究,方法及原理均不相同。上年度進行人造油溶性樹脂之研究時,亦曾涉及此項研究,其結果頗可資爲參考。故是項研究,殊饒興趣,幷有實用上之價值。茲擬分爲兩部進行:(一)利用國產磁土爲接觸劑,(二)用高壓加熱,以覘其結果之優劣。

(九)氣相高壓裂餾棉子油之研究

此項研究,上年度即已計畫進行,因儀器之製造需時,未能早日進行。現儀器之主要部分,已裝置完畢,附件不日亦可裝配齊全,即可進行研究。

(十)蓖蔴油製潤滑油之研究

蓖麻油供飛機潤滑劑之用,由來已久,市上兼有礦物油攙和品。但平常蓖麻油與礦物油不相混合,須採特殊製煉方法方有效。上年度經作多次初步試驗,已獲相當結果,下年仍擬繼續研究。

PREPARATION OF OIL-SOLUBLE RESIN FROM POLYHYDRIC ALCOHOL AND POLYBASIC ACID. II.

JEN-CHUAN WEE (韋鏡權)

In the previous contribution on the same topic in the Report 1935, the preparation of an oil-soluble resin was reported. It is principally the introduction of fatty acid into the alkyd molecule to produce a resinous matter soluble in oil. It seems possible to prepare a great number of oil-soluble resins by varying the nature of oils, alcohols and fatty acids. Since the fatty acids and alcohols have their own special structures and properties, any one fatty acid radical or alcoholate radical in alkyd resin would impart to the resin some properties characteristic to itself. The combination of the peculiarities of both fatty acid and alcohol radicals in one single resin would cause much complexity in its properties and variation in its preparation. With a view of performing some scientific work along this direction, several resins are prepared and studied in detail.

As some fatty acids of the non-drying type have close relation in structure to those of drying type, it is possible to convert some non-drying fatty acid into drying type by proper treatments, that is, non-drying oil may be converted to drying oil and utilized in resin manufacture. The author carried out a series of experiments with this aim in view and prepared successfully one kind of such resins. This result might throw light on the field of research for new methods in resin manufacture by using non-drying oils.

In the present work, two polyhydric alcohols, glycerol and pentaerythrite, are used to prepare two series of resins. The resins containing glyceride residue are prepared by the methods, which, following the same principle as mentioned in the previous contribution, are the combinations of alcoholysis and esterification. The resins containing the pentaerythride residue are prepared by the other methods, which simply compose of the esterification of pentaerythrite in one stage or two stages, though similar to Scheiber's process (3) in general, but are different from it in detail.

Experimental

Preparation of Different Types of Resins

1. Pyro-casto-phthalo-glycero-resin

The raw materials used to prepare this resin are glycerine, phthalic anhydride, caustic soda and castor oil. Glycerine has to be dehydrated at 250-260°C. As the raw castor oil can not be used directly in this case, it is heated in carbon dioxide atmosphere on a sand-bath to 295-300°C with constant stirring by means of a continuous stream of carbon dioxide gas. The heating is continued for four hours. The castor oil undergoes transformation and decomposition, and a drying oil is obtained, which has higher iodine value and saponification value, but lower acetyl value than the raw castor oil. The oil thus obtained is called pyro-castor oil.

136 parts of dehydrated glycerine, 660 parts of pyro-castor oil and 2.4 parts of caustic soda are mixed in a vessel, which is fitted with a stirrer, an outlet for vapor and an inlet for leading in carbon dioxide gas to the bottom of the vessel. The caustic soda is dissolved in a little water or alcohol before use, in order to make it completely miscible with glycerine and pyro-castor oil. The mixture is stirred energetically under an atmosphere of carbon dioxide and heated in an oil-bath. The temperature is kept at 250-260°C. for one and half hours, and a slow current of carbon dioxide is passed in for stirring. The caustic soda acts both as a promoter for the dissolving of glycerine and pyro-castor oil, and as a catalyst for alcoholysis and esterification. Then, the mixture is allowed to cool down to room temperature under carbon dioxide atmosphere.

271 parts of phthalic anhydride is added and carbon dioxide atmosphere is restored. The temperature is raised gradually, and the efficient stirring is applied to make thorough mixing of molten phthalic anhydride and the pyro-casto-glyceride, because the former is lighter and may cause gelatinization at surface when the reaction takes place and no uniform product can be obtained. Oil-bath is preferred in this process in order to get even heating and at no time is its temperature allowed to go higher than 10°C. above reacting mixture. The reacting mixture is constantly stirred by a slow current of carbon dioxide which serves as well to carry out the water vapor. When the temperature of reacting mixture reaches 200°C., the heating is cautiously controlled to keep the temperature at 200-210°C. for two hours. Drying the last twenty minutes, the temperature may be preferrably raised to 210-220°C. to improve the quality of resin, and quicker stirring is necessarily applied

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to prevent any possible local over heating. When the heating process reaches the final stage, the fire is removed and the resin thus obtained in quickly cooled by replacing the hot oil in bath with cold oil; this quick cooling is essentially, otherwise the resin would polymerize or have poorer solubility in oils and solvents. Stirring is continued until the temperature drops near 100°C. and the resin is rapidly taken out before it gets very viscous in the container at room temperature.

2. Tungo-phthalo-glycero-resin.

832 parts of Tung oil, 170 parts of glycerine and 4.2 parts of caustic soda are mixed under carbon dioxide. The air in the vessel must be displaced completely to prevent the oxidation of Tung oil during heating. The solid caustic soda has to be dissolved in small amount of alcohol before mixing. The reacting vessel used is the same as in the pyro-casto-phthalo-resin preparation. An evenly heated sand-bath may be used here. The mixture is vigorously stirred and quickly heated up to 250°C., and the temperature is kept at 250-260°C. for forty minutes. A current of carbon dioxide is continuously passed through the reacting mixture to carry off the vapor, and glycerine is refluxed down by a reflux condenser. Then, the temperature is rapidly raised to 280°C. while efficient stirring is maintained. The reacting mixture is kept at 280-290°C. for 10-15 minutes; longer heating would cause trouble in the next step in the process. The mixture is cooled immediately to room temperature under carbon dioxide, then transferred into another vessel, which is immersed in an oil-bath.

394 parts of phthalic anhydride is added to the cold Tungoglyceride obtained above. The air in vessel is displaced completely with carbon dioxide, then a slow current is maintained until the experiment is finished. The mixture is heated up rapidly; the temperature should rise to 190°C. in the least possible time, (within half an hour) even when large batch of material is handled. It is worth while to notice that the bath oil must not be heated over 210°C. in order to avoid any over heating of the reacting materials. When the temperature reaches about 100°C., the stirring is started with moderate speed in order to make thorough mixing of the ingredients. The temperature of the oil-bath and of the mixture is carefully controlled. A sudden rising or dropping in temperature may cause the reaction to be uncontrollable. When 190°C. is reached, the temperature is so adjusted as to raise to 200°C. gradually in a course of half an hour. In the next twenty minutes, it is steadily raised to 210°C. and finally to 215°C. The resin prepared is cooled and transferred in the same manner as in the case of pyro-casto-phthalo-glycero-resin.

3. Lino-phthalo-glycero-resin.

Raw linseed oil and glycerine are taken in the ratio of 778 to 167, and heated under an atmosphere of carbon dioxide above 250°C. for five and half hours. A slow current of carbon dioxide gas is passed in to stir the mixture and carry off any volatile matter. A great deal of albuminous matter in linseed oil is precipitated in the presence of glycerine. After heating has lasted two and half hours, the temperature is raised to 300°C. Finally the lino-glyceride is cooled under an atmosphere of carbon dioxide. The precipitate at bottom is removed to make the product clear.

31 parts of the clear lino-glyceride and 11 parts of phthalic anhydride are mixed in a vessel under carbon dioxide atmosphere. When the solid anhydride melts during heating, stirring is started. The temperature is kept at 240-250°C. for three and half hours. The water vapor resulting from the reaction condenses in the outlet and decreases in amount as the reaction goes to completion. The speed of the current of carbon dioxide is faster than that used in other similar preparations in order to prevent the darkening of the resin. The resin does not polymerize or gelatinize with ease, hence a longer time of heating is allowable. The resin is cooled with stirring under carbon dioxide just as in the case of other similar resins. It may be transferred when cooled on account of its high fluidity at room temperature.

4. Eleostearo-phthalo-pentaerythro-resin

The raw materials used are phthalic anhydride, α-eleostearic acid and pentaerythritol. The latter two compounds are prepared in the following manner. α-Eleostearic acid is prepared according to the procedure of Wang and Yang (4), with some modifications. 200 grams of high-grade Tung oil is refluxed with alcoholic potash consisting of 42 grams potassium dissolved in 400 ml. of 97% alcohol. The mixture is gently boiled on water bath for one hour. The clear hot solution is poured into 1500 ml. of 3% dilute sulfuric acid, and the mixture is stirred to make thorough acidification. On cooling, the cake of α-eleostearic acid above the aqueous layer is taken out, pulverized, washed, and then sucked dry. The crude α-eleostearic acid is purfied by recrystallization in 130 ml. of 97% alcohol, the alcohol being maintained at 35-40°C. and the acid is dissolved with stirring until saturation is reached. This solution is occasionally stirred to promote the crystallization when cooled. The crystalline α-eleostearic acid is filtered off, washed with small portions of alcohol, and then sucked dry. It is in the form of white shiny plates. The pure α-eleostearic acid is preserved under vacuum or under carbon dioxide in a dark and cold place,

because it is readily oxidized in contact with air. It is advisable to store this acid in small portions in separate containers when it is prepared in large amount.

Pentaerythrite is prepared by a modification of the procedure described in Organic Synthesis (I). One liter of ice-cooled water is mixed with 71 grams of acetaldehyde and 560 grams of 40% formalin with stirring. Sixty grams of freshly hydrated pure lime is added to the solution in large portions with efficient stirring in order to bring up quickly the necessary alkalinity. The mixture is then heated in a water-bath to 60-65°C. with energetic stirring for two hours. When the suspended solids settle to the bottom, the clear lemon-yellow solution is decanted off and then filtered. A sufficient quantity of 50% sulfuric acid is added to precipitate the calcium in filtrate as calcium sulfate, but no excess of sulfuric acid should be present. The mixture is warmed, and the solid calcium sulfate is filtered off after settling. A saturated solution of oxalic acid is cautiously added to the hot filtrate, until a filtered sample no longer gives test for calcium salts. The liquor is concentrated under reduced pressure to 350 ml. and decolorized with active carbon; the filtrate is left over night. Crystals of pentaerythrite separated out on standing, this product is washed with cold alcohol, and recrystallized from water. The yield is about 114 grams.

377 parts of α-eleostearic acid, 154 parts of pentaerythrite and 226 parts of phthalic anhydride are mixed by grinding and placed in an autoclave. The air in the autoclave is displaced completely by carbon dioxide gas. The oil-bath is then heated up and the mixture is agitated gently. The slow current of carbon dioxide gas is temporarily stopped until the temperature of the mixture reaches 150°C., at which temperature all the solid melts and the frothing no longer occurs. The temperature of the reacting mixture is kept at 165-170°C. for one and one quarter hours, and then raised gradually to 180°C. in one and half hours. During the heating the temperature of the bath-oil has to be cautiously controlled to avoid any sudden rising; stirring is restlessly applied. The increase of viscosity, which is an indication of the stage of reaction, may be observed from the appearance and color of the foams on the surface. If the foam at the outer edge of the reacting mixture does not subside, but gradually increases in amount and turns deeper in color, heating should be immediately stopped even when the usual requisite time of heating has not reached. This resin is very viscous and sticky when cold. Therefore it must be transferred under carbon dioxide when hot. If air leaks into the autoclave, the yellow color of resin will change to brown or dark red.

5. Ricino-phthalo-pentaerythro-resin.

The ricinoleic acid is prepared from the ricinolein, which is isolated in pure state from castor oil. A mixture of 90% petroleum ether and 10% benzene is used instead of the Kransnodar benzine in Panjutin and Rapoport's method (2). Castor oil is extracted with a sufficient quantity of this mixture four times, and the solvent in castor oil is distilled off, the pure glyceride of ricinoleic acid being thus left behind. This glyceride is saponified with alcoholic potash, the alcohol is distilled off after two hours' boiling, much water is added and the mixture is distilled to drive out all the alcohol. The residual solution is acidified with hydrochloric acid and extracted with ether. The ethereal solution is washed and dehydrated. Pure ricinoleic acid is left in flask after distilling off ether.

475 parts of ricinoleic acid, 4.5 parts of litharge and 153 parts of pentaerythrite are mixed together; the litharge is finely ground and mixed with pentaerythrite, then ricinoleic acid is added. This mixture is heated under carbon dioxide on oil-bath, with constant stirring, the temperature being kept at 190-200°C. for one hour. Then the temperature is raised to 250-260°C. and maintained at this temperature for half an hour. The product is cooled down to room temperature under an atmosphere of carbon dioxide.

198 parts of phthalic anhydride is added to the ricinoleic pentaerythride and a carbon dioxide atmosphere is established. The mixture is heated to 190°C. with stirring, the temperature is kept at 190-200°C. for one hour and then raised to 200-210°C. in the course of half an hour. The resin is freed from the white suspension by dissolving it in toluene and distilling the solution after warming and filtration. Carbon dioxide is passed in to promote distillation and to prevent the resin from oxidation.

The properties of the resins prepared are shown in Table I.

Table I. Properties and Analysis of the Resins.

	Pyro-casto-phthalo-glycero-resin.	Tungo-phthalo-glycero-resin.	Lino-phthalo-glycero-resin.	Eleo-stearo-phthalo-pentaery-thro-resin.	Ricino-phthalo-pentaery-thro-resin.
Density	1.0764	1.1093	1.0566	1.1182	1.0873
Color (Gardner color standard)	11	12	15	11	12
Acid value	37.1	59.8	21.4	91.3	54.2
Saponification value	327.8	340.1	332.0	345.6	319.5
Ester value	290.7	280.4	310.6	254.3	265.2

Iodine value (Hanus)	89.5	99.0	105.1	166.0	65.7
Drying rate in room (hours)	6¼	46	21½	5/6	8 days
Drying rate in sun light (hours)	5	2	3	2/6	14
Gloss (Ingersoll glarimeter)	99.8	99.8	99.8	99.8	99.4-99.8

By studying Table I, we can note the following points:

(1). Among the phthalo-glycero-resins, Tungo-phthalo-glycero-resin has the highest density, largest acid value and smallest ester value. And, in the phthalo-pentaerythro-resins, the eleostearo-phthalo-pentaerythro-resin has the greater density, larger acid value and smaller ester value. These two relationships are similar, and may be attributed to the presence of Tung oil acid radical in molecule. Because the eleostearo-phthalo-pentaerythro-resin is prepared from pure α-eleostearic acid, the variations in density, acid value and ester value are more significant. Since the Tung oil acid in the Tungo-phthalo-glycero-resin consists only partly of α-eleostearic acid, the variations in density, acid value and ester value from other resins are smaller than those of eleostearo-phthalo-pentaerythro-resins.

(2). Among the phthalo-glycero-resins, lino-phthalo-glycero-resin has the smallest density, least acid value and highest ester value. These characteristics are just opposite to those of the Tungo-phthalo-glycero-resin. The corresponding figures of pyro-casto-phthalo-glycero-resin have intermediate values, though approaching those of lino-phthalo-glycero-resin.

(3). The difference between the drying rate of pyro-casto-phthalo-glycero-resin in a room (diffused light) and its drying rate in direct sunlight is comparatively slight, while the corresponding difference for the other resin amounts to a considerable value. This shows that the fatty acid in pyro-casto-phthalo-glycero-resin has special characteristics and the cause of drying of such resin is somewhat different from others. The pyro-castor oil has been subjected to corresponding tests, and the results is similar to those of the pyro-casto-glycero-resin.

(4). From these results, the conclusion may be drawn that the nature of the fatty acid radical and alcoholate residue contributes to the corresponding resins certain characteristic properties.

Miscibility of Resins with Oils.

Lino-phthalo-glycero-resin is miscible with all oils and can be blended in any proportion. The other resins, when mixed with oil and

heated at the proper temperature, produce the blendings which can stand dilution with two to four times of petroleum solvent. It is noticeable that the resins may be very easily blended with the oils containing the same fatty acid radical. The tolerance to dilution of the resins prepared are shown in Table II.

Table II Tolerance to Dilution of the Resins.

	Pyro-casto-phthalo-glycero-resin.	Tungo-phthalo-glycero-resin.	Lino-phthalo-glycero-resin.	Eleo-stearo-phthalo-pentaery-thro-resin.	Ricino-phthalo-pentaery-thro-resin.
Alcohol	0.4	0.64	0.27	2.2	1.5
Ether	2.5	1.45	∞	10	∞
Mineral turpentine	4.5	0.8	„	0.5	0.7
Petroleum ether	0.5	0	„	0.25	0.33
Vegetable turpentine	∞	16.5	„	6	15
Toluene	34	3.2	„	3.3	30

From Table II we can see:

(1) All the resins are very soluble in vegetable turpentine, but less so in toluene.

(2) Phthalo-pentaerythro-resin is miscible with both ether and alcohol, and in this respect is quite distinct from phthalo-glycero-resin.

(3) Pyro-casto-phthalo-glycero-resin is similar to Tungo-phthalo-glycero-resin and different from lino-phthalo-glycero-resin with regard to its solubility in ether, petroleum ether, toluene and mineral turpentine.

(4) Lino-phthalo-glycero-resin is a peculiar member among the resins prepared in showing extremely low solubility in alcohol and extremely high solubility in other solvents.

Summary

(1) Three oil-soluble resins containing glyceride residue are prepared by alcoholysis of pyro-castor oil, Tung oil, and linseed oil respectively, with glycerine at 250-260C. with or without catalyst, and by esterification of the product with phthalic anhydride at different temperatures in the range of 190-250°C.

(2) Two oil-soluble resins containing pentaerythride residue are prepared respectively by (a) esterification of pentaerythrite with mix-

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