® HERCULES

YARMOR® 302

PINE OIL

ACCEPTED

NOV 25 1974

UNDER THE FEDERAL INSECTICIDE FUNGICIDE AND RODENTICIDE ACT FOR ECONOMIC POISON REGISTERED UNDER NO. 891-174

RECEIVED 11 NOV 1974 REGISTRATION DIVISION PESTICIDES, EPA

FOR FORMULATION OF DISINFECTANTS

ACTIVE INGREDIENT	
PINE OIL	99.4%
INERT INGREDIENT	
WATER	0.6%

RINSE EMPTY CONTAINERS THOROUGHLY WITH SOAP AND WATER BEFORE DISCARDING. FOR BULK CONTAINERS, FLUSH THOROUGHLY CLEAN WITH SOAP AND WATER BEFORE REUSE.

WARNING

KEEP OUT OF REACH OF CHILDREN

HARMFUL IF SWALLOWED. If swallowed, do not induce vomiting but call a physician. Vomiting may be harmful. Keep out of eyes. May cause eye damage or skin irritation. If contact with eyes occurs, flush with water immediately. Get medical attention. Avoid contamination of food.

YARMOR 302 PINE OIL MEETS REQUIREMENTS OF FEDERAL SPECIFICATION LLL-P-400a FOR TYPE 1 PINE OIL. FOR ADDITIONAL TECHNICAL INFORMATION CONCERNING USE OR PROPERTIES OF YARMOR 302 PINE OIL, SEE HERCULES TECHNICAL LITERATURE: BULLETINS OR-103, OR-104, OR-105, AND T-103A; DATA SHEET NUMBER 701.

E.P.A. REGISTRATION NO. 891-174
E.P.A. EST. NO. 00891MS01

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NET CONTENTS _____ **U.S. GALLONS**

ORGANICS DEPARTMENT • HERCULES INCORPORATED
WILMINGTON, DELAWARE 19899

HER. 22531 10-74 500 64458H
PRINTED IN U.S.A.

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TOXICOLOGICAL DATA

HERCULES PINE OILS

BULLETIN T-103A
(Supersedes T-103)

YARMOR® 302, 302W, AND F AND HERCO® PINE OILS[1] – SUMMARY OF TOXICOLOGICAL INVESTIGATIONS

Chemical Composition

HERCULES® PINE OILS are produced from liquid terpenes extracted from pinewood. They are mixtures consisting largely of tertiary terpene alcohols with minor amounts of terpene hydrocarbons, ethers, and ketones. The chemical compositions of commercial grades vary depending on end-use requirements. Yarmor 302 has the highest content of terpene alcohols (91%). The terpene alcohol content of the other pine oils – Herco (85%), Yarmor 302W (76%), and Yarmor F (75%) – is less, with correspondingly larger amounts of terpene hydrocarbons. Yarmor 302 and 302W were chosen as representative of the physiological properties of pine oil

Physical Properties

Hercules pine oils are clear, light-colored liquids with low volatility (distillation ranges from 5% at 198-212°C to 95% at 220-227°C). All have a mild pinelike odor that varies slightly with the differing terpene alcohol:terpene hydrocarbon ratios of the several grades. All are solvents for many resins, greases, oils, and waxes; exhibit antibacterial activity; and possess useful wetting, penetrating, dispersing, and suspending properties. Principal applications are in cleaners, disinfectants, polishes, paints, textile wet-processing aids, and as flotation reagents in the benefication of various metallic and nonmetallic ores.

(1) Hercules pine oils, Yarmor 302 and 302W and Herco grades, are registered with the Pesticide Division of the Environmental Protection Agency under EPA Registration Numbers 891-174, 891-176, and 891-175, respectively.

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Acute Oral Toxicity

Toxicological studies (rat, oral) indicate that the terpene alcohols and monocyclic terpenes in pine oil have essentially the same degree of toxicity. The results of these studies are reported on rats, with a comparison of undiluted pine oil on both rats and guinea pigs.

LD_{50} rats –	2,100 mg/kg (Yarmor 302, undiluted)
	3,200 mg/kg (alpha-terpineol)
	4,700 mg/kg (alpha-terpineol and secondary terpene alcohols)
	4,700 mg/kg (monocyclic terpenes)
LD_{50} guinea pigs –	1,300 mg/kg (Yarmor 302, undiluted)

Repeated Eye Irritation – Rabbits and Guinea Pigs

Application of 0.1 cc of undiluted pine oil (Yarmor 302) into the eyes of rabbits and 0.05 cc in the eyes of guinea pigs once a day for 15 days, without washing, produced progressive mild to moderate irritation and swelling of the eyelids and dilation of the blood vessels around the cornea. After last application, the irritation subsided until recovery was complete within 2 weeks.

Skin Irritation – Rabbits and Guinea Pigs

Application of undiluted pine oil (Yarmor 302) to the clipped backs of rabbits and guinea pigs daily for 15 days, without covering, produced a progressive drying, cracking, scaling, and sloughing of the superficial epidermal layer without apparent injury to the underlying layers in both species. Recovery was complete, with normal hair growth, within two weeks of the last application.

Irritation and Sensitization – Humans

Two hundred and ten subjects were patch-tested with 12.5% aqueous emulsion[1] of pine oil (Yarmor 302W) using the closed-patch technique. There was consistent slight erythema on the initial and challenge application and two subjects exhibited doubtful evidence of mild sensitization.

Twenty-three subjects were patch-tested with this same aqueous emulsion by the repeat-insult technique, closed patch. Nine repeated applications were made, followed by a challenge. Consistently mild erythema occasionally progressing to marked erythema and papules occurred during the repeat-insult phase. On challenge application, one subject showed doubtful evidence of sensitization.

(1) Tween 80 was used as the emulsifier. It is the twenty-mole ethylene oxide adduct of sorbitan monooleate produced by ICI United States Inc.

HERCULES

PRODUCT DATA

YARMOR® 302
PINE OIL

NUMBER 701-7

HIGHEST QUALITY, ALL-PURPOSE-GRADE PINE OIL

YARMOR® 302* pine oil is a clear, pale-yellow to near water-white oily liquid with a distinct pinelike odor. Derived from terpene oils of pinewood origin, it is a blend of related compounds, mainly terpene alcohols. Yarmor 302 meets requirements of Federal Specification LLL-P-400a for Type I pine oil. It is especially indicated for manufacture of top-performance cleaners, disinfectants, and for all other uses where a high-quality pine oil of uniform, highest terpene alcohol content is required.

Product Specification(1)

Specific gravity at 15.6/15.6°C	0.938-0.946
Total terpene alcohols, %	85 min
Moisture, %	0.6 max
Distillation range, °C	
5%	209 min
95%	225 max

(1) Hercules test methods used are available on request.

Typical Properties

Specific gravity at 15.6/15.6°C	0.941
Total terpene alcohols, %	91
Moisture, %	0.35
Distillation range, °C	
5%	212
95%	220
Refractive index at 20°C	1.481
Color, Hazen	20
Kauri-butanol value	>500
Flash point, TCC, °F (°C)	170 (77)
Weight per gal, lbs	7.85

Outstanding Characteristics

Clear, pale color; high terpene alcohol content; piney odor; high solvent activity; excellent wetting, penetrating, and dispersing properties; high bactericidal activity when properly formulated; uniform.

Miscible with most common organic solvents. Trace solubility in water.

*Hercules pine oil, Yarmor 302, is registered with the Pesticide Division of the Environmental Protection Agency under EPA Registration Number 891-174.

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Applications

Because of their outstanding surface-active properties; uniform piney odor; high solvency for resins, oils, fats, greases, and waxes; and high germicidal activity for gram-negative bacteria, Hercules® pine oils, including Yarmor 302, are especially suitable for formulation of disinfectants, disinfectant cleaners, industrial and household cleaners and sanitizers, textile printing specialties, defoamers and leveling agents in coating operations, and as ingredients for a variety of janitorial products and other chemical specialties. Since pine oils are essentially insoluble in water, most of the above indicated end-use products require a soap, nonionic surfactant, or other surface-active constituent to aid emulsification or dispersion of the pine oil when diluted for use.

HANDLING PINE OIL – PRECAUTIONS

WARNING:

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If swallowed, do not induce vomiting but call a physician. Vomiting may be harmful. Keep out of eyes. May cause eye damage or skin irritation. If contact with eyes occurs, flush with water immediately. Get medical attention. Avoid contamination of food.

For detailed information on the toxicological properties of Hercules pine oils, request Bulletin T-103A.

OSHA Classification

As Hercules interprets the Occupational Safety and Health Act of 1970, Yarmor 302 is a hazardous material because it is combustible. It has a TCC flash point of 170°F (77°C).

Container Disposal

Rinse empty containers thoroughly with soap and water before discarding. For bulk containers, flush thoroughly with soap and water before reuse.

HERCULES

TECHNICAL DATA

HERCULES®
PINE OILS

BULLETIN OR-104B
(Supersedes PC-104A)

HERCULES® PINE OILS[1] – NOTES ON STORAGE AND HANDLING

General

All tank cars and storage tanks used for the shipment and storage of pine oil in areas that annually experience prolonged periods of subfreezing weather should be equipped with steam coils. Railway siding and storage facilities should be located close to an available source of steam for heating when it may be required.

Construction Materials for Storage Tanks

Plain steel and aluminum are satisfactory for the construction of pine oil storage tanks. Carbon steel pipe is preferred for the heating coils. Flanged joints are more desirable than threaded ones. The number of pipe joints inside the tank should be held to a minimum or eliminated completely by welding. Brass fittings and copper heating coils are considered suitable.

The storage tank outlet should be placed 6 to 8 inches above the bottom to prevent contamination from small amounts of water and sludge that settle to the bottom of the tank. A drain valve at the low end of the storage tank should be provided for periodic removal of such accumulated water and sludge.

Location of Storage Tanks

Underground storage for pine oil is not recommended except where local regulations require this practice. Corrosion is a problem with buried tanks and clean-out is more difficult. The preferred installation is a well-insulated steel tank mounted on concrete supports and located as close as possible to the point of use.

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Grounding Storage Tanks

Where it is desired or required, pine oil storage tanks can be grounded by running a lead from a grounding clip on the tank to an underground metallic waterline. If there are no such lines within a practical distance, a Crouse-Hinds (or equivalent) copper-coated steel ground rod is a satisfactory alternative. The resistance of any ground connection to earth should preferably be less than 1 ohm; in no case should it be over 5 ohms. Resistance should be checked with a Megger or similar ground-testing instrument.

Freezing of Pine Oil During Cold Weather

The storage and handling of pine oil during exceptionally cold weather occasionally results in problems brought about by freezing or partial crystallization of its constituents. This is because high-grade pine oils are composed largely of terpene alcohols that, in the pure state, have melting points in the range of 95 to 104°F (35 to 40°C).

Since pine oil is made up of a number of different components, some of which are crystalline solids at normal temperatures, one might wonder why it is ever a liquid. The explanation is that it is a complex mixture, and, while predominantly comprised of terpene alcohols, pine oil also contains terpene ketones, ethers, and hydrocarbons. All of these are soluble in and compatible with each other, resulting in a mixture that will remain a liquid even though cooled to a point well below the freezing point of certain constituents. The exception to this is when crystalline material is present that might act as a seed to start crystal growth of one or more of its components.

When supercooled pine oil is seeded with a crystal of alpha-terpineol, the major component, crystals of the constituent will be precipitated until a mixture of crystals and liquid phase is formed that is in equilibrium under the temperature conditions that prevail. Ice crystals and rust particles also can act as nuclei to start crystal growth. Also, the agitation that the pine oil receives while being transported in tank cars further serves to promote crystallization in very cold weather.

Under the conditions described above, freezing of pine oil can occur. When it does, however, the pine oil can be restored to liquid form without loss of any properties by proper application of heat and agitation.

Heating Requirements for Storage Tanks

The heat requirements are not great during cold weather, when heating coils are used to warm pine oil. In the following example, the outside temperature is 20°F (−7°C); for an 8 by 25-foot steel tank of about 10,000-gallon capacity protected with 1 inch of insulation, 20 square feet of heating surface with steam at 20 pounds gauge pressure on the coils would maintain it at around 50°F (10°C).

To heat the contents of a 10,000-gallon tank of pine oil from 0 to 100°F (−18 to 30°C), as would be required in case of frozen pine oil, would require about 50 square feet of heating surface with steam at 20 pounds gauge pressure on the coils for a period of around 12 hours. Obviously, it would be advisable to provide somewhat greater heating surface and higher steam pressure to take care of still colder conditions.

Examination of Incoming Tank Cars

On arrival of tank cars of pine oil during the winter months, it is important to examine the contents for the presence of crystalline material. Even though no obvious layer of crystals is evident, scattered crystals may be dispersed throughout the liquid. If closer examination proves this to be the case, the contents of the tank car should be heated before unloading. Heat should be applied until all crystal nuclei are destroyed to prevent further crystallization on standing.

All tank cars used for shipping pine oil are provided with heating coils to permit melting of any crystallized pine oil that may form during transit in cold weather. When a tank car is received, the dome cover should be opened and the contents probed with a long wooden stick to determine the presence of any frozen material. As an additional precaution, if equipment is available, examine under polarized light for presence of minute scattered crystals.

If frozen or partially crystalline pine oil is detected, heat the contents until the crystalline material is completely melted. Then pump from out of the bottom into the top of the car for several hours until the contents are a homogeneous product. Do not remove the liquid portion only from a partially frozen tank car of pine oil, since the freezing action concentrates the terpene alcohols in the crystalline portion. Do not pump the melted material from the car into storage tanks or other containers until the contents of the tank car are completely liquified and free of suspended crystals. This could cause seeding and subsequent crystallization throughout the entire handling system.

Returning Empty Tank Cars

After unloading a tank car of pine oil, it is important to examine its interior to be certain that all liquid material is completely drained from the boot, and in subzero weather, to see that no crystalline deposits of pine oil remain. This assures the customer of receiving full quantity shipped, and puts the tank car in proper shape for return to Hercules.

Since it is impractical to recover minor quantities of pine oil remaining in returned tank cars, no credit will be issued for such residual material. If for any reason a full or partially unloaded tank car of pine oil is to be returned to a Hercules plant, prior arrangements should be made with a Hercules sales office. If not cleared for return, full responsibility for return freight and loss of material remains with the customer.

PROPERTIES OF PINE OIL

Specific Gravity vs Temperature

For engineering purposes, calculations may be made on the basis of increase or decrease of 0.00082 unit per degree change in centigrade temperature. This change per degree temperature has been determined in the laboratory and was that observed over the range of 0 to 30°C (32 to 86°F). It may be used as a correction factor for all grades of Hercules pine oils.

For example, to determine the specific gravity of Yarmor® 302 pine oil at 20/15.6°C calculate as follows:

Specific gravity at 15.6/15.6°C		= 0.9410
Change in temperature	20°	15.6° = 4.4°
Change in specific gravity		4.4 x 0.00082 = 0.0036
Specific gravity at 20/15.6°C	0.9410	0.0036 = 0.9374

When making calculations of specific gravity below 15.6°C, the number of degrees change in temperature multiplied by 0.00082 is added to the specific gravity of the pine oil at 15.6/15.6°C. When calculating values at temperatures higher than 15.6°C, the correction is subtracted, as in the example.

The change per degree Fahrenheit is estimated to be 0.00046 unit, and the calculation is made as illustrated above, subtracting or adding the correction to that of pine oil at 15.6/15.6°C (60/60°F), depending on temperature.

Density vs Temperature

The density-temperature relationship of pine oil is shown in Table I, below. A typical high-purity pine oil, such as Yarmor 302, was used in the determination.

Table I

Temperature °F	Temperature °C	Density, g/ml	Weight/ U.S. Gal, lbs	Temperature °F	Temperature °C	Density, g/ml	Weight/ U.S. Gal, lbs
5	-15	0.960	7.997	65	18.3	0.939	7.823
10	-12.2	0.958	7.983	70	21.1	0.937	7.809
15	-9.44	0.957	7.968	75	23.9	0.936	7.794
20	-6.67	0.955	7.954	80	26.7	0.934	7.780
25	-3.89	0.953	7.939	85	29.4	0.932	7.765
30	-1.11	0.951	7.925	90	32.2	0.930	7.751
35	1.67	0.950	7.910	95	35.0	0.929	7.736
40	4.44	0.948	7.896	100	37.8	0.927	7.722
45	7.22	0.946	7.881	105	40.8	0.925	7.707
50	10.0	0.944	7.867	110	43.0	0.924	7.693
55	12.8	0.943	7.852	115	45.8	0.922	7.678
60	15.6	0.941	7.838	120	49.0	0.920	7.664

Specific Heat

To determine the heat input required to raise the temperature of a vessel or tank car of pine oil, and to make other engineering calculations, a specific heat value of 0.5 is used for all pine oil grades.

Coefficient of Cubical Expansion

The coefficient of cubical expansion of Hercules commercial grades of pine oil per degree change in temperature is shown below:

	Per °C	Per °F
Yarmor 302 pine oil	0.00087	0.00048
Herco® pine oil	0.00088	0.00049
Yarmor 302W pine oil	0.00089	0.00049

Viscosity vs Temperature

Figure 1 illustrates the effect of temperature change on the viscosity of pine oil. Yarmor 302 pine oil was the grade tested and recorded here.

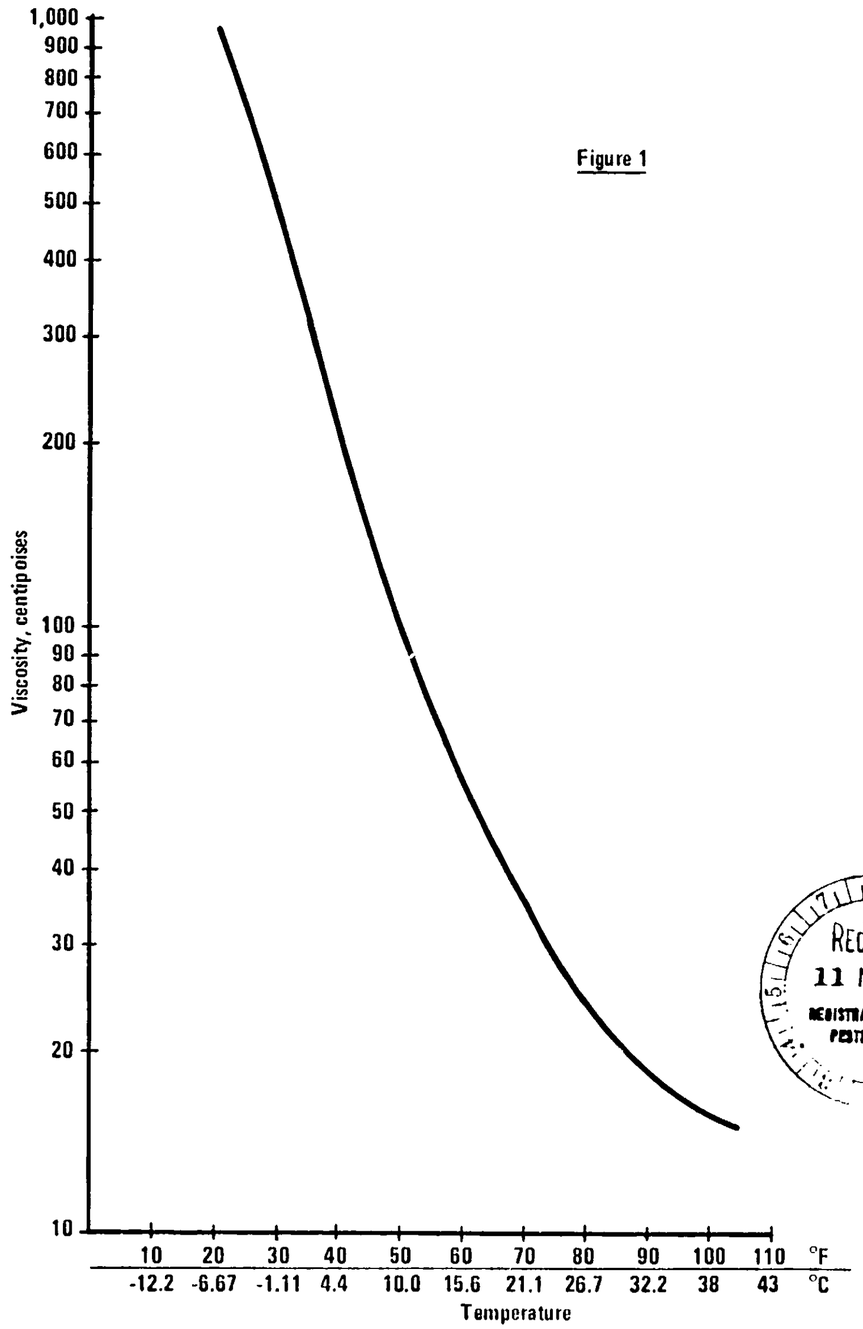

Figure 1

HANDLING PINE OIL – PRECAUTIONS

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For detailed information on the toxicological properties of Hercules pine oils, request Bulletin T-103A.

OSHA Classification

As Hercules interprets the Occupational Safety and Health Act of 1970, Yarmor 302 and 302W and Herco grade pine oils are hazardous materials because they are combustible (TCC flash points 170, 130, and 150°F [77, 54, and 66°C], respectively). Material Safety Data Sheets are available.

Container Disposal

Rinse empty containers thoroughly with soap and water before discarding. For bulk containers, flush thoroughly with soap and water before reuse.

HERCULES

TECHNICAL DATA

HERCULES®
PINE OILS

BULLETIN OR-103D
(Supersedes PC-103C)

HIGH-EFFICIENCY GENERAL-PURPOSE CLEANERS FORMULATED WITH HERCULES® PINE OILS[1]

Pine oil contributes many outstanding properties to industrial, institutional, and household cleaners. It has high solvency for oils, fats, and greases, and readily emulsifies these materials; accelerates wetting of hard surfaces; aids suspension of soil; has nonresidual and nonstaining properties; and is compatible with a large number of auxiliary solvents and couplers. In addition, pine oil imparts a pleasant and distinctive natural piney odor to the finished product.

Formulations A and B for two general purpose-type cleaners using Hercules® pine oil are given in Table I, page 2. The high performance of Formulations A and B is attributed to a selection of constituents designed to provide an optimum balance of detergent action required for easy cleaning of typical hard-surface materials.

Comparative performance tests by a well-known testing laboratory rated Formulations A and B superior to C and D, two commercial cleaners. Formulation A was rated highest in each of the tests on three types of surfaces. Formulation B, a slight modification of A, performed nearly as well.

Linoleum panels were installed in pedestrian traffic areas and soiled through normal use. The panels were shifted and rotated during the exposure period to equalize soiling. The tests used were designed to measure efficiency of cleaner formulations for cleaning soiled linoleum and glass surfaces, and for stain removal from painted surfaces.

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Table I
COMPARISON OF GENERAL-PURPOSE CLEANERS

Materials	Formulations[a] (Parts by Weight) A	B	C	D
Yarmor[R] 302 pine oil[b]	7.5	7.5		
Pamak[R] 4 fatty acid[c]	4.7	4.7		
Caustic soda	0.65	0.65	Liquid	
Ultrawet 35KX or equivalent[d]	24.0	–	Commercial-	
Ultrawet 60K or equivalent[d]	–	10.6	Type	
Conco SXS or equivalent[d]	–	3.75	Cleaners	
Tetrapotassium pyrophosphate	5.0	5.0		
Isopropanol	8.75	8.75		
Water	49.4	59.05		
	100.00	100.00		
Cleaning Efficiency				
Performance rating using recognized tests for evaluating hard-surface cleaners	Superior to all tested	Superior to C and D	Inferior to A and B	Poorest
Storage Stability				

Formulations A and B passed both freeze-thaw (3 cycles) and heat-stability (10 days at 120°F) tests.

(a) Blend the pine oil and fatty acids at room temperature. Stir in the synthetic anionic compounds followed by addition of the isopropyl alcohol. Add the caustic soda as 20 percent NaOH (assay 97 percent) aqueous solution, and continue stirring for 10 to 15 minutes (minimum). Stir in the pyrophosphate as a 15 to 17 percent aqueous solution. Then add the remaining water, and continue stirring until the product is homogeneous and clear.
(b) Hercules pine oils, Yarmor 302W and Herco grades, should prove equally satisfactory.
(c) Hercules tall oil fatty acids; typical acid number 180.
(d) These anionic surfactants were chosen for availability, performance, economics, etc.; similar products would be expected to be equally satisfactory.

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For detailed information on the toxicological properties of Hercules pine oils, request Bulletin T-103A.

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S/1/74

HERCULES PINE OILS
MISCELLANEOUS USES

Contents

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11 NOV 1974
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HERCULES INCORPORATED • WILMINGTON, DELAWARE 19899

INTRODUCTION

Hercules® pine oils are based on materials fractionated from oils extracted from pinewood. They are mixtures of terpenes, consisting largely of alcohols with minor amounts of hydrocarbons, ethers, and ketones. The major single constituent is the terpene alcohol, alpha-terpineol. Hercules pine oils are available in a range of terpene alcohol contents.

The predominant uses for pine oil – flotations of minerals and coal, preparation of textile specialties, and for compounding industrial and household cleaners and disinfectants – are so well known that they tend to overshadow the many equally important "miscellaneous" uses for this versatile terpene product.

Some of these lesser known uses are briefly reviewed in this publication. The qualifications of pine oil for these applications are a result of its unique balance of properties. These include its high germicidal, wetting, penetrating, and solvent power, along with its low volatility and full, but pleasant, pinelike odor.

PAINT AND VARNISH PRODUCTS

Solvent

Pine oils are used for a variety of purposes as raw material in the manufacture of solvent-type paint and varnish products. They are excellent resin solvents, and small percentages can be blended with low-solvency petroleum thinners to increase the solvency power of the latter.

Also, a small percentage of pine oil is extra protection against precipitation of solids in case an excessive amount of low-solvency thinner is added before application. In addition, it exerts an antiskinning effect during storage of the finished product.

Pigment-Grinding Aid

Pine oil, aside from being a strong solvent, is an excellent wetting agent. At a concentration of 3 to 5 percent of the vehicle, it improves the wetting of pigments during the grinding operation and aids their dispersion in grinding vehicles. It is especially effective for grinding pigments in synthetic resin vehicles, although it is also efficient in grinding pigments for most oleoresinous varnishes and drying oils. Because of its high boiling point, pine oil is reported to go farther (less loss through volatility), and does a more efficient job than most other solvents usually employed as grinding aids. Examples of the beneficial effects of pine oil in this application are presented in more detail in Technical Data Bulletin OR-101B entitled, "Hercules® Pine Oils in Organic Coatings Useful Grinding Aids, Leveling Agents, and Consistency Controllers."

Leveler

As a part of the finished paint product, pine oil improves the brushing and leveling properties. It is especially effective when the paint is applied to surfaces that are hard to wet.

In baking varnishes and enamels, it contributes to their flow properties, which result in even and level finishes without pinholing. This again is because of its high solvency for resins and excellent wetting action. A variety of industrial enamels contain a small amount of pine oil (2-5%). In wire enamels, pine oil greatly minimizes pinholing. This beneficial effect is very closely related to the use of pine oil in paper coating to produce smooth, level finishes without pinholes or "bird's eyes."

Water-Base Paints

In emulsion or water-base paints, pine oil in small percentages is an effective preservative for protein stabilizers. It also contributes to leveling and provides a pleasant odor to the product.

PAINTBRUSH CONDITIONER

Keeper

Linseed oil, kerosene, turpentine, or mixtures of these materials are often used to keep or preserve oil-base paint brushes when they are not in use. For this use, however, they have certain shortcomings. Linseed oil gradually oxidizes to form rubbery, gel-like particles. Mixtures of linseed oil with either or both turpentine and kerosene have the same tendency to gel. Turpentine alone oxidizes in contact with air and is sufficiently volatile to evaporate to a considerable degree. Kerosene likewise evaporates, is a poor solvent, and presents a fire hazard.

Pine oil, on the other hand, has definite advantages used as a paintbrush keeper alone or in combination with other solvents. Pine oil itself does not oxidize appreciably and is sufficiently nonvolatile so that little loss from evaporation is encountered. Furthermore, it is a much better solvent for dry or partially dry paint than the materials mentioned above. Because of these superior properties, it is an ideal medium for storing paintbrushes. A minimum amount of rinsing with a low-cost solvent or soap and water, or just brushing out, is all that is needed before reuse of the brush.

Cleaner

The advantages of pine oil in all-purpose household cleaners apply to their use as paintbrush renewers or cleaners as well. In these products, the high solvency of pine oil for dry or partially dry paints is augmented by the presence of soap emulsifiers. The latter materials in combination with pine oil provide an economical water-base brush cleaner

PLYWOOD ADHESIVES

Antifoam Agent

Pine oil is an effective antifoam agent, preservative, and wetting agent for interior plywood adhesives containing casein, soybean, or other protein as the binding medium. These materials have a marked tendency to foam under conditions of mixing and application. To minimize foaming, the use of about 2 percent Yarmor® 302 pine oil based on the solids content of the adhesive is very effective.

Preservative

Pine oil also acts as a preservative for proteinaceous materials used in these adhesives. When a permanent preservative is required, such as one of the chlorinated phenols, pine oil acts as a solvent for it. A further function of pine oil in plywood adhesive formulations is as a wetting agent. Acting as such, it promotes even spreading and distribution of the laminating adhesive when it is applied.

The pine oil is usually incorporated when the casein or other protein is dispersed in water. Although pine oil is nearly insoluble in water, the alkaline solutions of the proteins are excellent dispersants, and no additional emulsifier is required to keep the pine oil suspended.

OTHER MISCELLANEOUS USES

Degreaser and Fat Liquoring

In degreasing sheepskins, the removal of oils and greases that are present in the skins is usually accomplished by the use of petroleum solvents. In such solvents, the addition of about 5 percent pine oil, based on the volume of solvent used, will give much better results than the solvent alone. This is because of the outstanding penetrating and wetting-out properties of pine oil. A much more thorough degreasing is obtained with a more even deposition of any remaining trace amounts of grease in the hide. This allows for a more uniform dyeing of the degreased sheepskin.

Pine oil is also beneficial in the fat liquoring operation. The substitution of about 5 percent pine oil for 15 percent of the fat liquoring oil will give the same results at lower cost.

Blood Preservative

Dried animal blood is the protein base for one type of plywood laminating adhesives, and meat-packing houses are a prime source of blood for this purpose. Some of the larger packing companies do their own spray-drying of the blood; and when it is routinely processed, no preservatives are required.

Other meat packers, however, do not have spray-dry facilities; and in these cases, the by-product blood is periodically collected by tank truck and taken to

a central location for drying. The collected blood is primarily a mixture of beef and swine, along with minor amounts of lamb and poultry blood.

Being a proteinaceous material, animal blood is subject to bacterial degradation and, accordingly, must be protected with a preservative during storage and transit. General practice is to add pine oil at the collecting site, at the rate of about 0.5 percent based on the weight of whole blood. In very warm weather, slightly more may be required. The pine oil serves both as a preservative and to impart a pleasant odor to the whole blood until it can be dried.

GRADES OF HERCULES PINE OILS

Hercules pine oils suitable for use in the preceding applications include: Yarmor® 302, Herco®, and Yarmor 302W. They differ primarily in specific gravity and terpene alcohol content. The choice of proper grade depends on the type of product being formulated, and such other factors as economics, quality, and efficiency required. Typical physical and chemical properties of these grades of pine oil are given in Table I.

Table I

TYPICAL PROPERTIES OF HERCULES PINE OILS

	Yarmor 302	Herco	Yarmor 302W
Specific gravity at 60/60°F (15.6/15.6°C)	0.941	0.933	0.923
Refractive index at 20°C	1.481	1.481	1.481
Color	← colorless to pale yellow →		
Total alcohols, %	91	85	76
Flash point, TCC, °F (°C)	170 (77)	150 (66)	130 (54)
Freezing point, °F (°C)	<50 (<10)	<32 (<0)	<5 (<-15)
Kauri-butanol solvency value	>500	>500	>500
Viscosity, Ubbelohde at 77°F (25°C), cps	18	–	6.5
Moisture, %	0.35	0.35	0.35
ASTM distillation range, 5-95%, °C	212-220	205-220	198-220