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FINAL REPORT
ON
SALES SERVICE WORK ON FUNCTIONAL FLUIDS
1956

Job No. 2-02-750.01-3133

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Reported by: J.D. Sullivan

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INTRODUCTION

During the past year, Pydraul 60, Pydraul 625 and Pydraul AC have been added to Skydrol 7000, Pydraul F-9, 150 and 600 to compliment Monsanto's established line of functional fluids. Skydrol 7000 is a fire-resistant aircraft hydraulic fluid and the Pydrauls are fire-resistant industrial fluids. In an effort to answer customer's queries concerning the life and utility of these fluids under specific operating conditions, samples of used fluids were evaluated for reuse, system deposits were analyzed and recovery techniques were investigated. These activities have been labeled sales service work and are detailed in this report.

SUMMARY

Service was rendered to six companies on Skydrol 7000 and to thirty-four companies on the Pydraul series. Additional samples were dispatched directly to the J.F. Queeny Analytical Laboratory and the results of these analyses were referred to the Sales Department for transmission to the individual customers. Such activities have helped in securing Monsanto's present position in the field and in the promotion of functional fluids.

REFERENCES

(1) Final Report "Hydraulic Fluids and Synthetic Lubricants" Job No. 117-2080 by R. E. Hatton, May 15, 1952.

(2) Final Report on Functional Fluids, Job No. 117-2380 by R. E. Hatton, May 21, 1953.

(3) Final Report, "Functional Fluids - Application Research 1952-1954", Job No. 117-2508 by R.E. Hatton, L.W. Bannister, W.E. Koerner, O.B. Cecil, August 4, 1954.

(4) Final Report, "Functional Fluids - Application Research 1954-1955", Job No. 2-02-750.01-2815 by R.E. Hatton, July 6, 1956.

(5) Final Report "Navy Shipboard Fluid", Job No. 3011, Part I November 11, 1955 by R.S. Mitchell.

(6) Final Report "Sales Service Work on Functional Fluids 1954-1955", Job No. 2633 by R.E. Hatton, April 2, 1956.

EXPERIMENTAL WORK AND DISCUSSION

A. References to Memos

Analyzing used fluids, employed in various applications, gives the Sales Department an opportunity to offer a special service to their customers and enables research to keep abreast with the current problems of the field. Any general fluid information, acquired through this channel, which could be directly applicable to future problems is recorded in discussion found in this report.

Evaluations of fluids of immediate interest to particular applications have been reported in memo form to the Sales Department for transmittal to the individual customer and the results of these analyses will not be repeated in this report. The attached table lists the customers concerned, a reference to the Monsanto personnel requesting the information and the date of the request. The Research notebook pages, on which the results of the original analyses were entered, are also listed for permanent record of the problem.

B. General Fluid Information

(1) Pydraul F-9

(a) Transition Oil Application

The recent sample of TCP (Tricresyl phosphate) received from the Arkansas Die Casting Company was entirely different in appearance and compatibility with transition fluid than the sample previously submitted from the same source. The recent sample was a black single layer fluid containing a substantial amount of finely dispersed foreign material. Filtration of the fluid through Dicalite rendered a clear brownish oil having a specific gravity of 1.1464 at 25°/25°C. Diluting the filtered fluid, 50% by volume, with Aroclor 1248 gave a light brown clear oil having a specific gravity of 1.2992 at 25°/25°C. A similar dilution of the unfiltered TCP with Aroclor 1248 resulted in a slightly turbid dark brown fluid completely compatible after a one-week shelf test. These formulations of Aroclor 1248 and TCP are compatible in Pydraul F-9.

Since the specific gravity specification of Pydraul F-9 is 1.275 to 1.295, the reported gravity of a 50% by volume mixture of 1.148 TCP and Aroclor 1248 will serve as a convenient method of calculating the required amount of transition oil (Aroclor 1248) required for this particular system.

(b) Effect of Pydraul F-9 on Garlock 660 Gaskets

Immersion tests on samples of Garlock 660 static gasket material from Clearing Machine Company showed satisfactory dimensional stability in Pydraul F-9. Three samples of this packing showed no measurable change after being immersed in Pydraul F-9 at 150°F. for 100 hours. Shore A hardness of both new and Pydraul F-9 aged samples was 88-90.

(c) Pydrauls with Nitric Acid, Liquid Oxygen or Methylene Chloride

1. Laboratory experiment has shown that no obvious reaction occurs between 70% nitric acid and Pydraul F-9 at room temperature. Fuming nitric acid does react with Pydraul F-9 at room temperature. Increasing the temperature would undoubtedly cause reaction with the 70% nitric acid.

2. Our Pydrauls are not considered to be compatible with liquid oxygen in respect to explosive reactions. Pydrauls are fire-resistant fluids and can be oxidized.

3. By experiment, Pydraul F-9 is compatible with methylene chloride at room temperature in a 50:50 mixture.

(d) Miscibility of Soluble Oil and Pydraul F-9

Following is a discussion of the miscibility of soluble oil and Pydraul F-9.

A.O. Smith Company of Houston, Texas submitted a sample of a soluble oil from Socony-Mobil which was used to lubricate bearings of butt welders. This oil was to be used in equipment in which Pydraul F-9 was proposed as the hydraulic fluid. Leakage of both fluids and water will be collected through settling pits and if possible, the Pydraul F-9 is recovered. The compatibility of the soluble oil and its interference with Pydraul F-9 separation from water were studied.

The soluble oil was found to be miscible with Pydraul F-9 in 5, 10, and 25% concentrations at about 50°C. Separation occurred in all cases on cooling to room temperature.

Five and ten percent solutions of soluble oil in Pydraul F-9 were prepared and then shaken with ordinary tap water in 25, 10, 5, and 1% concentrations. In all cases some foaming was observed, foaming being less at the lower concentrations. On standing overnight, the 1 and 5% concentrations in water gave clear lower liquid layers. It would therefore appear that dilution of a 5 to 10% solution of soluble oil in Pydraul F-9 with a large amount of water (10 to 100 volumes) would give a separable layer. To determine if the layer were principally Pydraul F-9, a 5% solution of soluble oil in Pydraul F-9 was prepared, diluted with 20 volumes of water, shaken and allowed to stand overnight. The lower layer was separated. Such treatment reduced the specific gravity, 25/25°C. from 1.285 to 1.267. At least part of this reduction could be due to water dissolution in the Pydraul F-9.

In view of these experiments, it was recommended that, if such a system as proposed is used, the recovered Pydraul F-9 be analyzed before reuse. Only rather dilute solutions of soluble oil in Pydraul F-9 should be allowed and dilution with large amounts of water is required.

(2) Pydraul 150

(a) Corrosion Tests on Specimens of a "B" Valve

Corrosion tests were run on specimens of a "B" valve from the Askania Regulator Company in the presence of Pydraul 150. Two samples, having equal exposed areas were cut from the test valve, partially submerged in the fluid and placed in an electrically

controlled oven at 180°F. One sample was maintained under these test conditions for 450 hours, and the second sample was held for 1100 hours. Pydraul 150 samples were exposed to the same test conditions in order to determine the increase in acidity due to heating alone. Following are the results of these experiments.

After 450 hours at 180°F. - The brass sample showed slight signs of staining, especially at the liquid level line. The corrosion loss was one milligram per 12 sq. cm. exposed area. There was essentially no acidity development due to heating Pydraul 150 for this period in the presence of the brass sample.

After 1100 hours at 180°F. - Brass sample showed slight signs of staining, especially at the liquid level line. The corrosion loss was one milligram per 12 sq. cm. exposed area. The acidity of the Pydraul heated in the presence of the brass sample was only 0.09 NN, whereas the Pydraul alone had an acidity of 0.22 NN after being heated at 180°F. for 1100 hours. The acidity of the Pydraul 150 before heating was 0.07 NN.

Since the corrosion loss was the same after 450 hours and 1100 hours, the loss appears to be initial attack and is not considered excessive. The actual lowering of the acidities of Pydraul type fluids upon prolonged heating in the presence of metals, especially copper, has been observed before and this phenomenon is under study at the present time.

(3) Emulsified Pydraul 600

A sample of Pydraul 600 taken from a Clearing Press at the East Hartford Works of Pratt and Whitney Aircraft was received as a complete emulsion. Filtering the entire sample through Whatman #2 filter paper failed to break the emulsion. Following is the analysis of the fluid after filtration through #2 Whatman.

Spec. Grav. at 25/25°C.	1.2894
Moisture	0.20%
Acidity	0.01 NN

Filtering the emulsified fluid through Dicalite 586-B resulted in a fairly clear yellow fluid having the following physical properties.

Spec. Grav. at 25/25°C.	1.2786
Moisture	0.09%

The specific gravity specifications for Pydraul 600 are from 1.357 to 1.365 at 25/25°C. Although filtration through Dicalite 586-B broke the emulsion and substantially reduced the moisture, we feel the fluid is too contaminated for reuse even after such a treatment. Plotting the specific gravity of Pydraul 600 and hydrocarbon oil (S.G. 0.8) against the percentage composition of the fluid indicates that this sample of Pydraul 600 would contain from 15% to 20% oil or other material of similar specific gravity.

(4) Pydraul AC

Effect of Pydraul AC on Synthane Rotary Compressor Blades

A synthane rotary compressor blade was submitted by the Worthington Corporation of Harrison, New Jersey to check its resistance to the action of Pydraul fluids. This composition vane, from the high pressure element of a Fuller air compressor, was essentially unaffected after immersion in Pydraul AC (OS-67) at 150°C. for 30 days.

(5) Skydrol 7000

Effect of Skydrol 7000 on Noelting-Faultless Casters

A Noelting-Faultless Caster, PR 3 x 1-1/4", was immersed in Skydrol 7000 for ten days. The combination of caster and Skydrol was held at 40°C. (104°F.) in an electricallly heated thermostatically controlled oven. This treatment resulted in no change in physical dimensions of the caster, practically no change in physical appearance, and no significant change in hardness as measured by the Rockwell Hardness Tester. Based on these data, it can be said that soaking the caster in Skydrol 7000 at 40°C. for ten days results in no significant change in the caster.

(6) Shelf Test on Irus 902

Long term shelf tests on Irus 902, a water-oil emulsion fluid, produced by Shell Oil Company, were conducted to determine the emulsion stability of the new fluid. Shell's Irus Fluid 902 settled into a double layer separated by a substantial interface. The separation began in one day and at the end of three weeks the top layer was about 25% of the original volume.

ACKNOWLEDGEMENT

The analyses performed by the members of the J. F. Queeny Plant Analytical Laboratory are gratefully acknowledged.

J. D. Sullivan

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EVALUATION OF USED FLUIDS

Company	Location	Fluid	Reference	Record
Steward Warner	Chicago, Illinois	Pydraul F-9	MCP, 1-13-56	A-75736
Goldsmith Mach. Co.	Elmera, N. Y.	Pydraul F-9	MCP, 1-18-56	A-75739
[illegible] Gas Transmission	Houston, Texas	Pydraul F-9	JBD, 1-20-56	A-75742
Frico Prod. Co.	Buffalo, N.Y.	Filter Sludge	FHL, 1-24-56	A-75718
Hoover Company		Pydraul F-9	MCP, 1-24-56	A-75745
Stewart Die Casting	Chicago, Illinois	Pydraul F-9	MCP, 2-10-56	A-75746
U.S.S. Fairless Works	Fairless Hills, Pa.	Pydraul F-9	MCP, 3-2-56	A-75738
Eastern Metal	Fort Smith, Ark.	Pydraul F-9	RD, 5-23-56	A-84119
Mall Tool Co.	Chicago, Illinois	Pydraul F-9	RD, 6-14-56	A-84123
Alcoa	Cleveland	Pydraul F-9	MCP, 7-26-56	A-84126
Alcoa	Cleveland	Residue	MCP, 7-26-56	A-84126
Bolling and Strand	Stockholm, Sweden	Pydraul F-9	APV, 8-13-56	A-84136
Hoover Company	N. Canton, Ohio	Pydraul F-9	MCP, 4-19-56	A-79836
Rochester Prod.Div.(GM)	Rochester, N.Y.	Pydraul F-9	MCP, 5-2-56	A-79839
Anchor Hocking Glass Co.	Lancaster, Ohio	Pydraul 150	RD, 5-29-56	A-84121
		Residue		
Granite City Steel Co.	Granite City, Ill.	Pydraul 150	MCP, 6-25-56	A-84124
Granite City Steel Co.	Granite City, Ill.	Pydraul 150	MCP, 6-21-56	A-84124
Wheeling Steel Co.	Steubenville, Ohio	Pydraul 150	MCP, 12-12-55	A-75744
Weirton Steel Co.	Weirton, W. Va.	Pydraul 150	MCP, 1-31-56	A-75745
U.S. Steel Co.	Gary, Indiana	Pydraul 150	RD, 6-18-56	-------
Oil Gear	----------	Pydraul AC	MCP, 6-21-56	A-84125
Kenney Eng.	Union, New Jersey	Pydraul Ac	JBD, 8-4-56	A-84135
Oil Gear Co.	Milwaukee, Wis.	NYVAC-600 (Pydraul 600)	MCP, 12-13-55	A-75743
Miss. River Fuel	Crystal City, Mo.	Pydraul 600	MCP, 3-27-56	A-79831
Monsanto	Australia	Skydrol	FHL, 3-26-56	A-79830
General Electric	W. Lynn, Mass.	Skydrol	FHL, 5-5-56	A-79835
Flying Tigers	California	Skydrol	RD, 5-29-56	A-84120
KLM	Test Stand	Skydrol	FHL, 7-27-56	A-84127
Flying Tigers	California	Skydrol	APV, 8-21-56	A-84128
R.W. Brown	Downey, Calif.	Irus 902	MCP, 4-25-56	A-84118
Shell	----------	Irus 902	MCP, 8-21-56	A-84137
Harrison Die Casting Co.	Harrison, Ark.	TCP	MCP, 3-29-56	A-79832
Cameron Iron Works	Houston, Texas	Oil	RD, 4-24-56	A-79833