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PROPERTIES OF ASPHALT MADE FROM ATHABASKA BITUMINOUS SANDS

by

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CONTENTS

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INTRODUCTION

The commercial development of the Athabaska bituminous sands will ultimately depend upon the ability to produce, profitably, material that will meet the requirements of the consumer both as to price and as to quality. The total cost of manufacturing marketable products can only be determined by actual trial, but considerable information regarding the quality of the products can be obtained from laboratory investigations. This is particularly true of data related to asphalts, since these products can be prepared quite readily on a small scale. It is with the thought that the data included herewith may be of some value in building up complete and comprehensive information on the material that this report is being published. The work was undertaken by the Fuel Research Laboratories of the Bureau of Mines in 1932 and the co-operation of Imperial Oil, Limited was obtained. The tests described in this report were conducted by Imperial Oil, Limited in the laboratories at the Montreal East refinery. The writer wishes to acknowledge the assistance and cordial co-operation of F.C. Mechin, Refinery Superintendent; C.M. Baskin, Asphalt Technologist; Paul Le Bel, Assistant Chemist, and other members of the staff of Imperial Oil, Limited.

PREPARATION OF SAMPLES

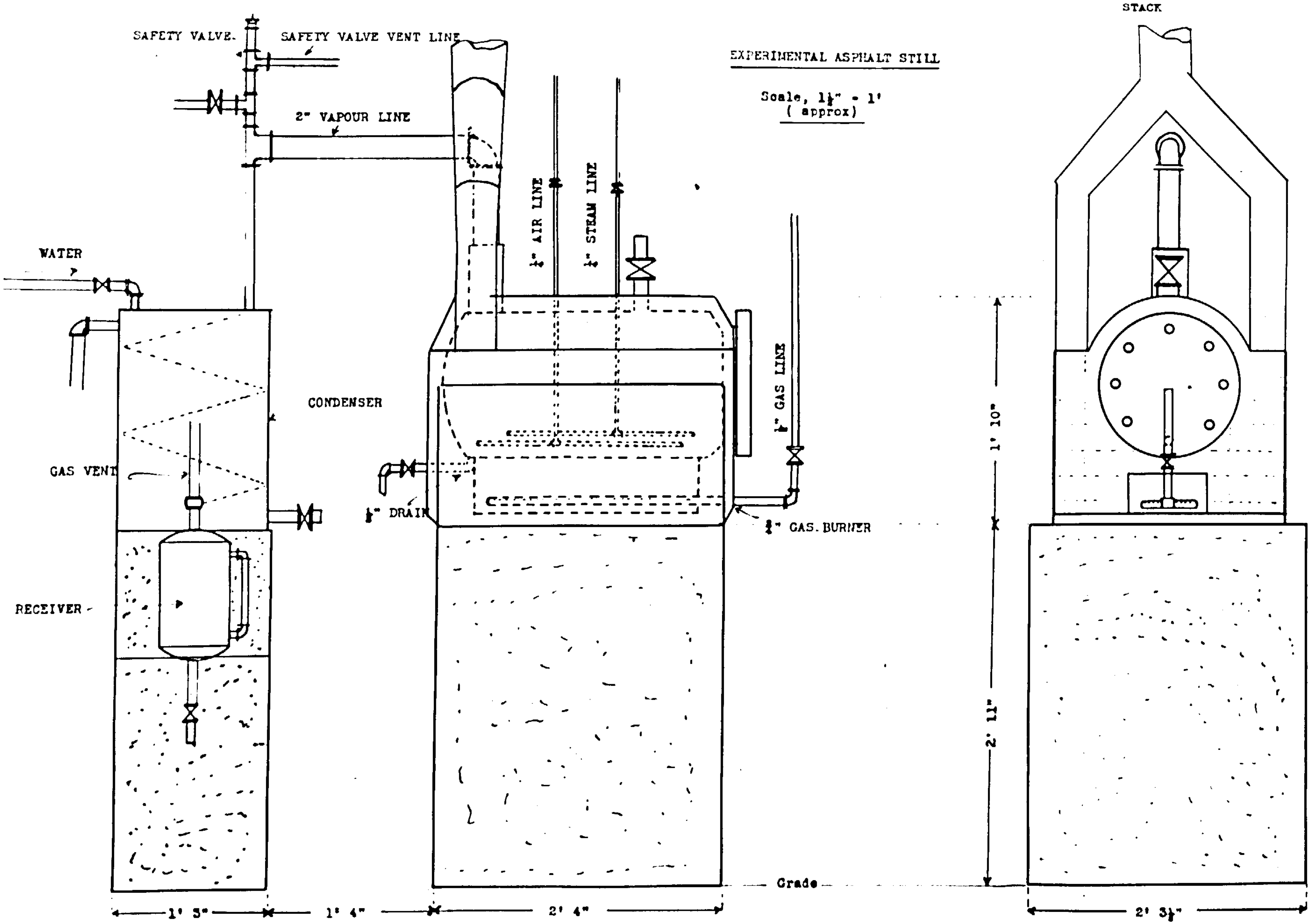
Two samples of bitumen from Athabaska bituminous sands were used in the work; the first, No. 7295, was obtained from the Clarke Separation Plant near McMurray, Alberta, and the second, No. 7921, was from the experimental plant of International Bitumens, Limited, Bitumont, Alberta, about 50 miles down the Athabaska River from McMurray.

The usual physical characteristics of these two samples were determined, and the results have been tabulated in Table 1. As the crude, untreated bitumen did not conform to approved specifications it was necessary to process the material in order to obtain products having physical properties approximating those of the current grades of refined asphalts in commercial use.

TABLE 1

Characteristics of Bitumen

Sample No.	7295	7921
Specific gravity at 60°F.	1.03	1.005
Moisture	Trace	0.2%
Mineral matter	2.5%	3.9%
Melting point	102°F.	45°F.
Flash point (open cup)	320°F.	250°F.
Fire point	410°F.	330°F.
Viscosity, Furol at 210°F.	775 secs.	98 secs.
at 250°F.	210 secs.	50 secs.
Penetration at 77°F.	230	Too soft



SIDE ELEVATION

END ELEVATION

The usual means adopted to obtain asphalts from petroleum refinery residues is to distil off as much of the volatile portion as is necessary to obtain the desired properties. The distillation can be carried out either with or without steam being present in the still, but the presence of steam during the distillation improves the properties of the product obtained. A modification of the product can be obtained by blowing air through the hot residue, thereby oxidizing some of the constituents present. Obviously the softening point, degree of hardness, penetration, etc., of the final product depends to a considerable degree upon the length of treatment.

Consequently, it was decided to reduce the volume of the bitumen by distillation with steam, which process is known in the industry as "steam reduction", in order to obtain a series of samples of different grades. The grades chosen were differentiated by the softening point of the material, and softening points of 120°F., 130°F., 140°F., 160°F., and 200°F. were selected as being probably the most useful. It was also decided to obtain a series of samples by oxidizing some of the bitumen by blowing air through it in order to obtain samples having softening points of 120°F., 130°F., 140°F., 160°F., 200°F., 220°F., 240°F., 260°F., and 300°F. After this preliminary work was done the physical properties of the different samples were determined.

DESCRIPTION OF APPARATUS AND METHOD

The apparatus used for reducing the bitumen by steam and for oxidizing it is shown in Figure 1. Briefly, it consists of a gas-heated shell still of about 8 gallons capacity, with a vapour off-take leading to a condenser and a receiver. Connections are provided so that steam and compressed air can be forced into the still. A small outlet is provided to permit withdrawing samples as required. The whole apparatus is suitably lagged and provided with necessary accessories such as valves, gauges,etc.

Reduction with Steam

To make a reduction with steam the still is charged with about 5 gallons of bitumen and gradually heated to 450°F. Steam is then passed through the bitumen by means of a perforated pipe located near the bottom of the still, and the distillate consisting of water and light oil is collected in the receiver. Periodically, small samples of bitumen are drawn off through the sampling outlet, and their softening points determined. The steaming and heating is continued until material of the desired softening point is obtained, at which point the amount of distillate is recorded in order to obtain an estimate of the yield of each fraction. The residual asphalt is drawn off for subsequent testing or a portion of it, about one-half gallon, can be withdrawn and the remainder of the residue may be given further treatment in order to provide samples with higher softening points.

Oxidation with Compressed Air

The bitumen to be oxidized is first separated from the lighter oils it contains by steam reduction, as described above, until an asphalt is obtained which has a softening point of 110°F. As the oxidation of an asphalt is an exothermic reaction in the initial stage it is necessary to cool the 110°F. softening point residue, or base stock, to a temperature of 375°F. before introducing the air which is forced in through a spray similar to that used for steam reduction. After oxidation is started the

TABLE 2

Data on various asphalts produced from Sample No.7295

Experimental Run No.212

Steam reducing bitumen to:	Liquid still temperature(^{o}F)	Fractions distillate Sp.Gr. at 60^{o}F	Fractions distillate % by Vol.	Asphalt produced, yield on bitumen % by Vol.	Asphalt produced, yield on bitumen % by Wt[x]
120^{o}F. S.P.	585	.954	0-15	85.00	86.05
130^{o}F. "	620	.954	15-21	79.00	80.55
140^{o}F. "	620	.969	21-24	76.00	77.70
160^{o}F. "	630	.979	24-30	70.00	71.90
200^{o}F. "	640	1.000	30-63	37.00	39.80

Experimental Run No.214

Steam reducing bitumen to 110^{o}F. S.P.(x) and oxidizing this base stock to:	Liquid still temperature(^{o}F)	Asphalt produced: % (by Vol.) yield on base stock	Asphalt produced: Yield on bitumen % by Vol.	Asphalt produced: Yield on bitumen % by Wt.
120^{o}F. S.P.		98.30	91.5	
130^{o}F. "		96.80	90.0	No deter-
140^{o}F. "	460	95.20	88.5	minations
160^{o}F. "	to	92.40	86.0	made of
200^{o}F. "	470	86.70	80.5	weight of
220^{o}F. "		83.30	77.5	overhead
250^{o}F. "		79.10	73.5	
260^{o}F. "		77.60	72.0	
300^{o}F. "		71.00	66.0	

(x) The yield of this 110^{o}F. S.P. base stock is 93.00% (by Vol.) on the bitumen tested and 95.00% (by Wt.).

TABLE 2 (cont.)

Data on various asphalts produced from Sample No.7921

Experimental Run No.213

Steam reducing bitumen to:	Liquid still temperature (^{o}F)	Fractions distilling, Sp.Gr. at $60^{o}F$	Fractions distilling, % by Vol.	Asphalt produced, yield on bitumen % by Vol.	Asphalt produced, yield on bitumen % by Wt.[x]
$130^{o}F$. S.P.	620	.947	0-26	74.00	75.43
$140^{o}F$. "	625	.979	26-29	71.00	72.49
$160^{o}F$. "	640	.979	29-38	62.00	63.70
$200^{o}F$. "	675	.993	38-57	43.00	44.90

Experimental Run No.215

Steam reducing bitumen to $110^{o}F$. S.P.(x) and oxidizing this base stock to:	Liquid still temperature (^{o}F)	(By Vol.) % yield on base stock.	Yield on bitumen % by Vol.	Yield on bitumen % by Wt.
$120^{o}F$. S.P.		98.70	81.00	
$130^{o}F$. "		97.60	80.00	No deter-
$140^{o}F$. "	$460^{o}F$.	96.90	79.50	minations
$160^{o}F$. "	to	95.20	78.00	made of
$200^{o}F$. "	$470^{o}F$.	90.80	74.50	weight of
$240^{o}F$. "		86.60	71.00	overhead
$260^{o}F$. "		84.70	69.50	
$300^{o}F$. "		80.40	66.00	

(x) The yield of this $110^{o}F$. S.P. base stock is 82.00% (by Vol.) on the bitumen tested and 83.00% (by Wt.).

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amount of air is decreased or increased as required to maintain an asphalt temperature of 460°F. to 470°F. as uniformly as possible. If the air is introduced at too high a rate the reaction may proceed so vigorously that true combustion occurs, whereas the introduction of air at too low a rate prolongs the operation and necessitates extra heating. The oxidation process differs from the steam reduction process in that very little oil distillate is obtained and the yield of asphalt is higher. As in the case when reducing by steam, small samples are drawn off periodically for testing, the "blowing" being continued until samples with the desired softening points are obtained, at which time larger samples are drawn off for subsequent investigation.

Yield of Asphalt

The yields of asphalt of various softening points obtained by steam reduction were calculated from the volume of the oil distilled over, proper corrections being made for variation in specific gravity in order to obtain the weight of the oil recovered. The results obtained are given in Table 2. The yields of oxidized asphalts of various softening points were calculated on the basis of the oxidizing base stock or of the bitumen under study. In compiling the results for this report the actual yields were measured only for the highest softening point grade of asphalt produced; the yields of intermediate stocks being assumed to be a linear function of the softening point. The results obtained are given in Table 2.

ANALYTICAL DATA

Samples of asphalt prepared as described above were tested according to accepted procedure for flash and fire point, ductility, penetration, viscosity, etc. The results obtained are given in Table 3. In addition to the results given in Tables 2 and 3, the relation between yield and softening point of the various asphalts produced is shown graphically in Figure 2; the relation between penetration and softening point is shown in Figures 3 and 4; and the relation between viscosity and softening point is shown in Figures 5 and 6.

For purposes of comparison there have been brought together in Table 4 the characteristics of some of the oxidized asphalts made from Athabaska bitumen with those of some refined asphalts produced from various crude oils imported from different parts of the American Continent.

SIGNIFICANCE OF TESTS

Asphalts are composed of high boiling point hydrocarbons. The exact chemical constitution of these hydrocarbons is not known, but they are usually separated into three groups according to their characteristics and are known as "oily constituents", "resins", and "asphaltenes".(1) The oily constituents have the appearance of heavy lubricating oils. The resins are sticky substances intermediate in property between the oily constituents and the asphaltenes. The asphaltenes are small black or brown hydrocarbon particles suspended in the oily constituents and resins. The precise properties of asphalts depend upon the relative amount of oily constituents, resins, and asphaltenes present in the material, but all asphalts have certain general properties, among which the following may be mentioned:

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(1) Imperial Oil Review, Volume 27, No.4.

TABLE 3

ANALYTICAL DATA

ON VARIOUS ASPHALTS PRODUCED EXPERIMENTALLY

(A) From: #7295

Steam Reduced to -	FLASH PT (o.c) °F (Cleveland)	FIRE PT °F. Cleveland)	SOFTENING PT (B. & R.) °F	DUCTILITY at 77°F. Cms.	VISCOSITY (FUROL) at 300°F Secs.	at 350°F Secs	at 400°F Secs	PENETRATION 200 gms 60 secs at 32°F	100 gms 5 secs at 32°F	100 gms 5 secs at 77°F	100 gms 5 secs @ 100°F	50 gms 5 secs @ 115°F	SUSCEPTIBILITY Pen. at 100°F / Pen. at 77°F	YIELD (by vol) %
Experimental Run #212														
120°F. S.P.	485	540	121	+110	147	53	--	22	5	75	t.s	t.s	---	85.0
130	500	590	130	+110	285	64	--	12	3	36	175	180	2.9	79.0
140	500	600	145	+110	295	84	--	8	1	24	100	105	4.2	76.0
160	550	660	158	24	339	151	41	4	0	10	40	40	4	70.0
200	565	685	197	0	1415	309	104	2	0	4	12	11	3	37.0
Experimental Run #214 Steam Reduced to 110°F.S.P. and oxidized to -														
120°F S.P.	410	480	122	+110	187	60	25	21	6	67	200	240	3.0	91.5
130	415	495	130	+110	232	91	31	12	6	48	123	153	2.6	90.0
140	430	515	139	54	417	123	43	10	4	33	75	94	2.3	88.5
160	460	535	160	9	1005	169	68	6.5	3	16	35	43	2.2	86.0
200	470	555	198	nil	t.h	970	207	4	1	7	13	14	1.9	80.5
220	475	565	219	nil	t.h	2234	349	3	1	5.5	8	9	1.5	77.5
250	475	565	252	nil	t.h.	t.h.	617	2.5	0.5	3	7	7	2.3	73.5
260	485	570	258	nil	t.h	t.h.	1027	2	0.5	3	6	5	2.0	72.0
300	595	660	302	nil	t.h	t.h.	t.h.	1	0	0	1	3	--	66.0

(B) From: #7921

Steam Reduced to -	FLASH PT	FIRE PT	SOFTENING PT	DUCTILITY	VISC. at 300°F	at 350°F	at 400°F	PEN. 200 gms 60 secs at 32°F	100 gms 5 secs at 32°F	100 gms 5 secs at 77°F	100 gms 5 secs @ 100°F	50 gms 5 secs @ 115°F	SUSCEPTIBILITY	YIELD
Experimental Run #213 Steam Reduced to -														
130°F. S.P.	520	620	130	+110	215	67	30	12	2	39	135	195	3.5	74.0
140	540	655	141	+110	302	91	38	10	0.5	27	85	130	3.1	71.0
160	555	690	160	27	445	140	49	4	0	12	38	51	3.2	62.0
200	555	710	198	0	t.h	710	169	1	0	1	5	5	5	43.0
Experimental Run #215 Steam Reduced to 110°F. S.P. and oxidized to -														
120°F S.P.	455	570	120	+110	165	66	23	28	8	100	t.s.	t.s.	---	81.0
130	460	565	132	60	221	108	37	13	6	39	120	170	3.1	80.0
140	490	595	141	28	436	133	45	10	2	29	90	130	3.1	79.5
160	500	600	159	12	556	221	66	6	0	15	50	63	3.3	78.0
200	500	605	213	nil	t.h	t.h	278	2	nil	4.5	11	13	2.5	74.5
240	535	630	244	nil	t.h.	t.h.	1200	nil	nil	1	1	2	1	71.0
260	545	640	258	nil	t.h.	t.h.	t.h	nil	nil	1	1	2	1	69.5
300	565	650	300	nil	t.h.	t.h.	t.h.	nil	nil	0.5	0.5	0.5	1	66.0

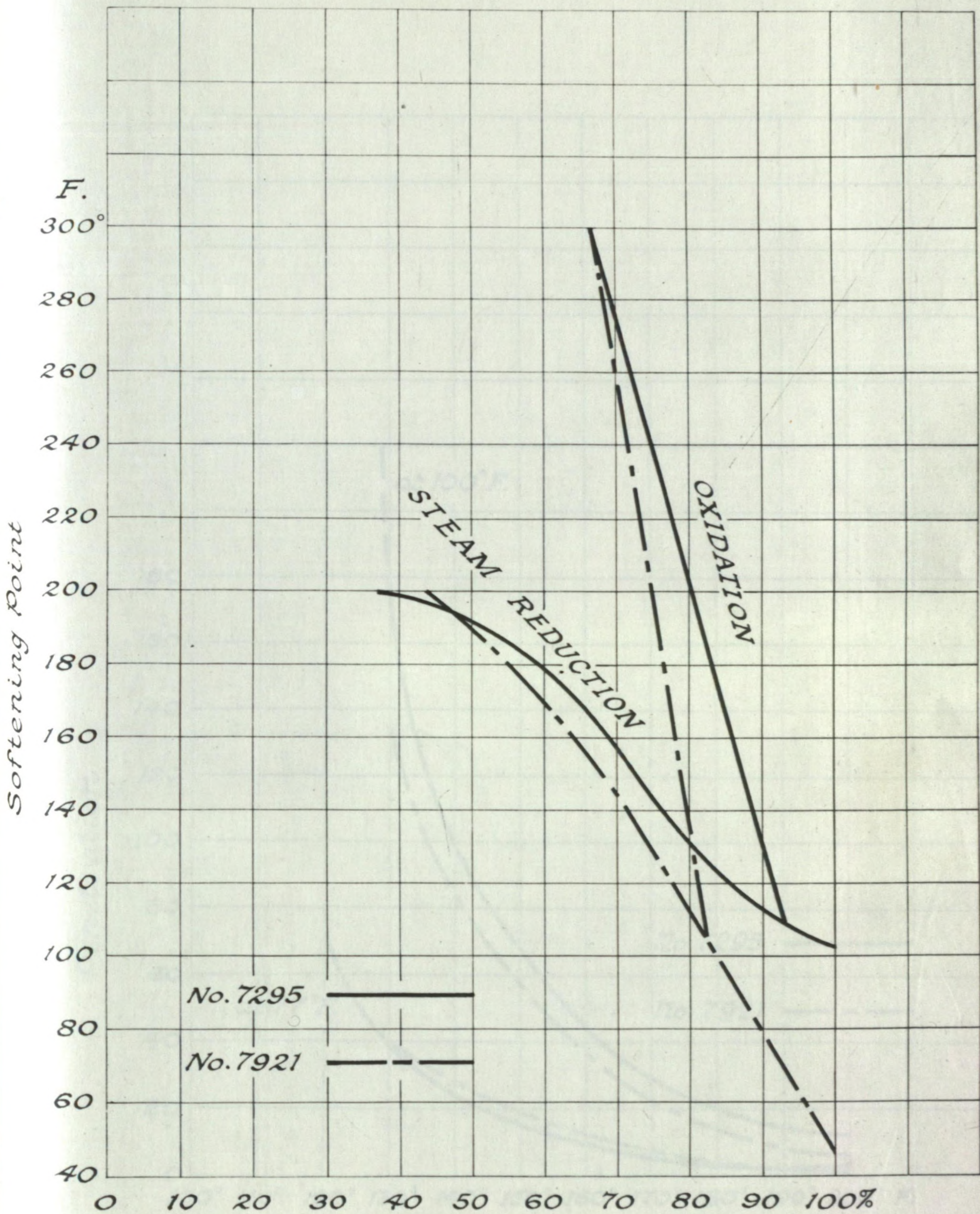


Figure 2. Softening Point - Yield Curves for oxidised and steam reduced bitumens.

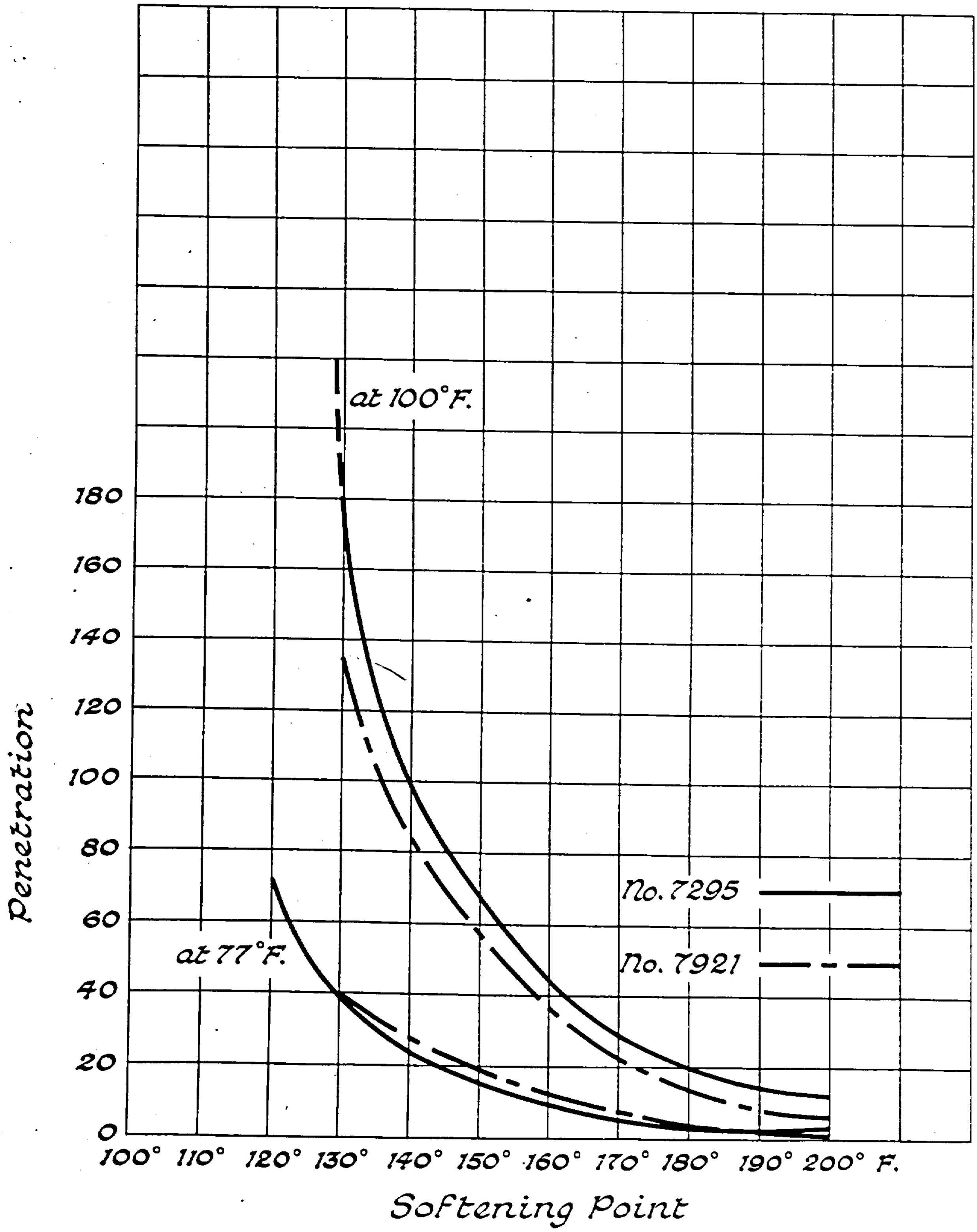


Figure 3. Penetration - Softening Point Curves for steam reduced bitumens.

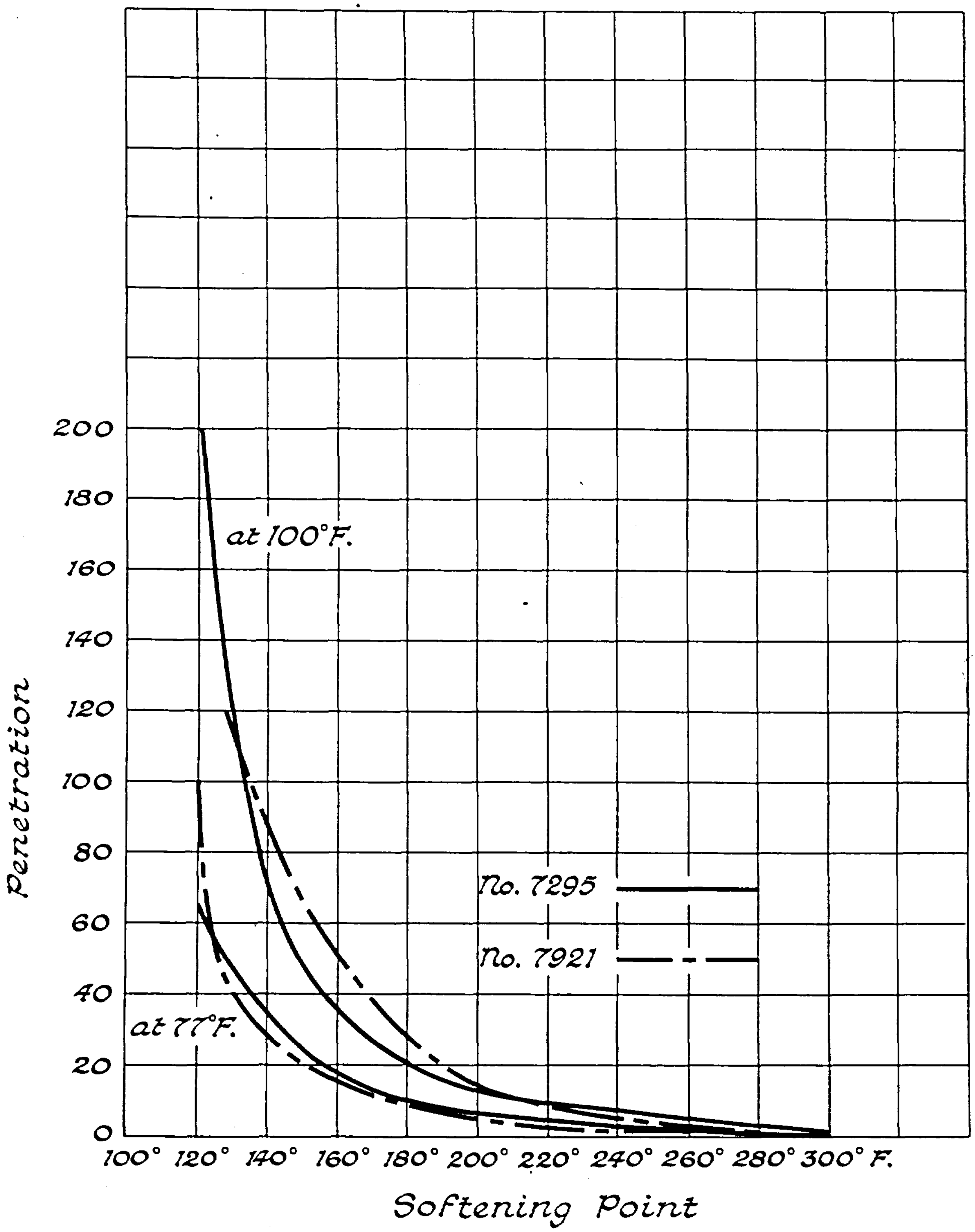


Figure 4. Penetration - Softening Point Curves for oxidised bitumens.

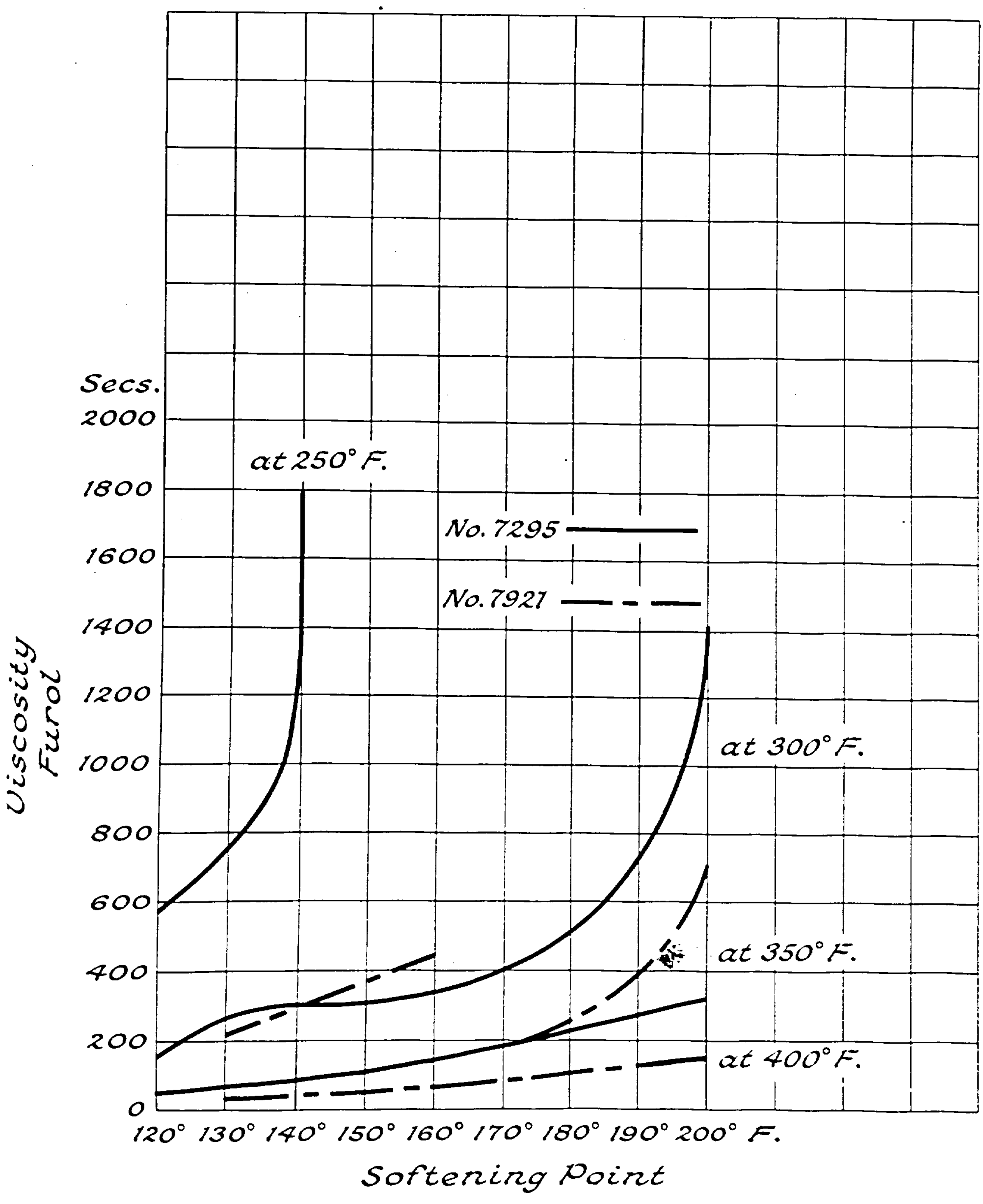


Figure 5. Viscosity - Softening Point Curves
for steam reduced bitumens.

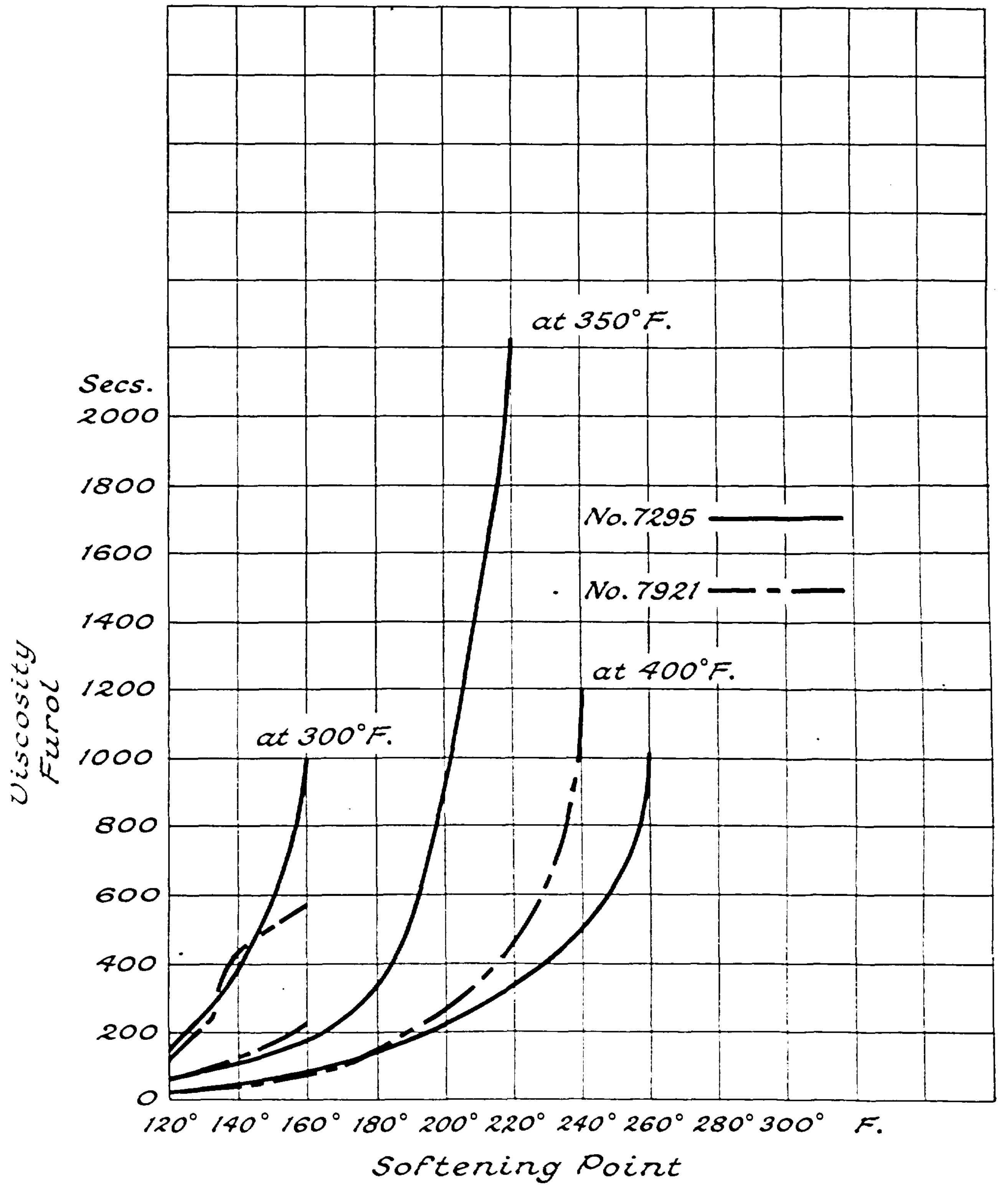


Figure 6. Viscosity - Softening Point Curves for oxidised bitumens.

<u>Chemical Inertness</u>: Asphalts are generally inert to acids or alkalis.

<u>Water Resistance</u>: One of the most characteristic properties of asphalts is their ability to repel water, and this property is used to improve the property of a large number of different commodities.

<u>Adhesiveness</u>: Adhesiveness is also an important characteristic of asphalts and may be defined as their ability to act as a cement. This is the property used in road construction whereby the asphalt serves as a cement to bind the aggregate together.

<u>Insulation</u>: Asphalts are non-conductors of electricity, and asphalt is used in compounds intended for insulating electric wires and cables, at the same time protecting them from deterioration due to moisture. Asphalts are also poor conductors of heat.

<u>Resilience</u>: Some grades of asphalt display a certain ability to recover their shape after being deformed.

The above properties are characteristic of all asphalts to a greater or less degree, but asphalts are not usually graded by making use of these characteristics. For practical purposes they are graded according to the following properties:

<u>Viscosity</u>: The viscosity of liquids is a measure of their ability to flow at the temperature at which the test is made, and the viscosity of liquid asphalts is determined in the same manner as the viscosity of lubricating oils. Viscosity may be considered the measure of the consistency of liquid asphalts.

Softening Point: Asphalts do not melt at a definite temperature, but soften gradually when heated. Consequently, the softening point of an asphalt may be defined as the temperature at which it softens when tested according to arbitrarily defined test procedure. The softening point of asphaltic materials varies from about 70°F. to over 350°F. It may be considered a measure of the consistency of semi-solid and solid asphalts taken in conjunction with the penetration test.

Penetration: The hardness of an asphalt is determined by the penetration test. In this test the distance which a standard needle will penetrate into an asphalt at a specified temperature in 5 seconds under a given load is measured. The less the penetration the harder the asphalt.

Ductility: The ductility of asphalts is a measure of the ability of the material to be drawn out into long thin threads. It is measured by the distance to which a briquette of the asphalt will elongate before breaking when the ends of the briquette at a specified temperature are pulled apart at a specified rate. The significance and value of the ductility test would appear to be rather questionable at the present time. It used to be thought that the quality of an asphalt was in direct relation to its ductility figure, but according to Baskin(2) "its contradictory character is decidedly apparent when lined up in relation to properties that seem to have some definite bearing on quality and source".

(2) C.M. Baskin: Asphalt, Its Chemistry, Significance of Source and Effect of Modern Processes on Present Day Specifications. Proceedings of the Association of Asphalt Paving Technologists, 1932.

TABLE 4

COMPARATIVE ANALYSES OF VARIOUS

REFINED OXIDIZED ASPHALTS

Source of production	Softening pt. °F. (B + R).	Ductility at 77°F. (Cms)	Penetration (100 gms.5 secs) 77°F.	100°F.	Susceptibility factor Pen.at 100°F / Pen.at 77°F
No.7295 Alberta bitumen	130	+110	48	123	2.6
	139	54	33	75	2.3
	160	9	16	35	2.2
No.7921 Alberta bitumen	132	60	39	120	3.1
	141	28	29	90	3.1
	159	12	15	50	3.3
x Illinois crude	133	27	30	93	3.1
x California crude	144	31	21	70	3.5
x Panuco(Mexico) crude	144.5	12	40	94	2.4
x Colombia crude	147.5	14	39	92	2.4
x Quire Quire(S.America) crude	148	40	16	47	2.9
x Panuco (Mexico) crude	155	10	42	91	2.2

x C. M. Baskin: Imperial Oil Refineries, Ltd., Montreal.

Susceptibility Factor: All asphalts do not soften to the same extent when heated through the same temperature range, and this characteristic is defined as the "susceptibility factor". The susceptibility factor of an asphalt is obtained by dividing the penetration measured when the asphalt is at 100°F. by the penetration measured when it is at 77°F. This characteristic of asphalts is somewhat similar to that known as the viscosity index of lubricating oils. Unless otherwise stated, the load used in the penetration test is 100 grams and the time is 5 seconds. The susceptibility factor is a very important characteristic of an asphalt, as it indicates its resistance to temperature changes, and the lower the susceptibility factor the more suitable the asphalt is. Low susceptibility and good weathering properties generally go together, although susceptibility as an indication of resistance to weathering requires further investigation.

DISCUSSION OF ANALYSES

Specifications for asphalts usually require specific softening points and penetrations. In Table 5 are shown the results obtained from a number of asphalts prepared from bitumen from Athabaska bituminous sands in comparison with asphalts prepared from typical crude petroleums. It will be observed that the figures for penetration show close agreement, especially in the higher softening point grades. From these results it would appear quite feasible to process bitumen from Athabaska bituminous sands to any required consistency and hardness.

TABLE 5

Sample	Softening point(B&R)	Penetration(100 gms. 5 secs.) at 77°F.	at 100°F.
Clarke's Bitumen		48	123
International Bitumen, Ltd.	130°F.	39	120
Illinois		30	90
Clarke's Bitumen		33	75
International Bitumen,Ltd.	140-145°F.	29	90
California		21	70
Panuco (Mexico)		40	94
Clarke's Bitumen		16	35
International Bitumen,Ltd.	150-160°F.	15	50
Quire Quire (Venezuela)		16	47

It will be noted in Tables 3 and 4 that the ductility figures for asphalt prepared from Athabaska bitumen having a softening point of 130°F. are distinctly higher than the figures for asphalt prepared from Illinois crude having a softening point of 133°F., viz., over 110 and 60 as against 27. The difference between asphalts having a softening point of 140°F. is not as great, viz., 54 and 28 as against 31 and 12. The figures for asphalts having a softening point of 160°F. are almost identical, viz., 9 and 12 as compared with 10.

It will be noticed in Table 4 that the susceptibility factors of the oxidized asphalts from Athabaska bitumens, viz., 2.2 to 3.3, are almost identical with those of oxidized asphalts from various crude oils, viz., 2.2 to 3.5. The asphalts from sample No.7295 are slightly superior to those from sample No.7921, in that the susceptibility factors are slightly over 2 and in some of the higher softening point grades as shown in Table 3 the value is even below 2.

From the data shown in Table 3 and that summarized in Table 4, it will be seen that generally speaking blown asphalts from Athabaska bitumen are quite similar to those obtained from various crude oils insofar as physical tests are concerned.

WEATHERING TESTS

The ability of asphalt to withstand weathering is an important property in many applications, and it may be related somewhat to the general characteristic of adhesiveness which was referred to above. It is obvious that a practical weathering test would require long periods of time in order to obtain conclusive results, and therefore the rapid testing of asphalt coatings to determine their probable relative durability under service is an important laboratory test. The determination involves two distinct requirements, first, it is necessary to subject the coatings to conditions which will cause rapid deterioration of the character encountered in actual service, and, second, it is necessary to determine the degree to which the coatings have failed under the test conditions. For bituminous material intended for use in the preparation of roofing materials, light, moisture, and rapid temperature changes are the most important causes of deterioration. For determining the relative degree of deterioration in asphalts Shelley[3] states that visual examination is considered sufficient.

The weathering properties of asphalt prepared from Athabaska bitumen were not known, and to obtain information on this point accelerated weathering tests similar to those reported by Shelley were conducted on a series of asphalts prepared from the extracted bitumen. The tests were made on prepared asphalts so that the results would have greater practical value because the properties of the crude untreated bitumen do not conform to those of asphalts in commercial use.

Method and Apparatus for Accelerated Weathering Tests

The apparatus used for these tests (popularly called a weatherometer) has been developed by the Bureau of Standards[4]. It consists of a rotating cylinder made of No.16 gauge galvanized iron, 30 inches in diameter and 15 inches high, open at both ends, with an arc light suspended in the centre as shown in Plate I. This cylinder has a capacity of 60 test specimens measuring 3 inches by 6 inches which are placed in two tiers immediately opposite the light inside the cylinder, thus being 15 inches from the centre of the light source. A pan placed at the bottom of the cylinder containing water, serves to humidify the air and keep down the temperature of the panels. An enclosed type

(3) P.G. Shelley: Accelerated Weathering Properties of Oklahoma Asphalts; Circular No.19, Oklahoma Geological Survey, Norman, Oklahoma.

(4) Accelerated tests of organic protective coatings by P.H. Walker and E.F. Hickson, Bureau of Standards Journal of Research, 1 p.1 (1928).

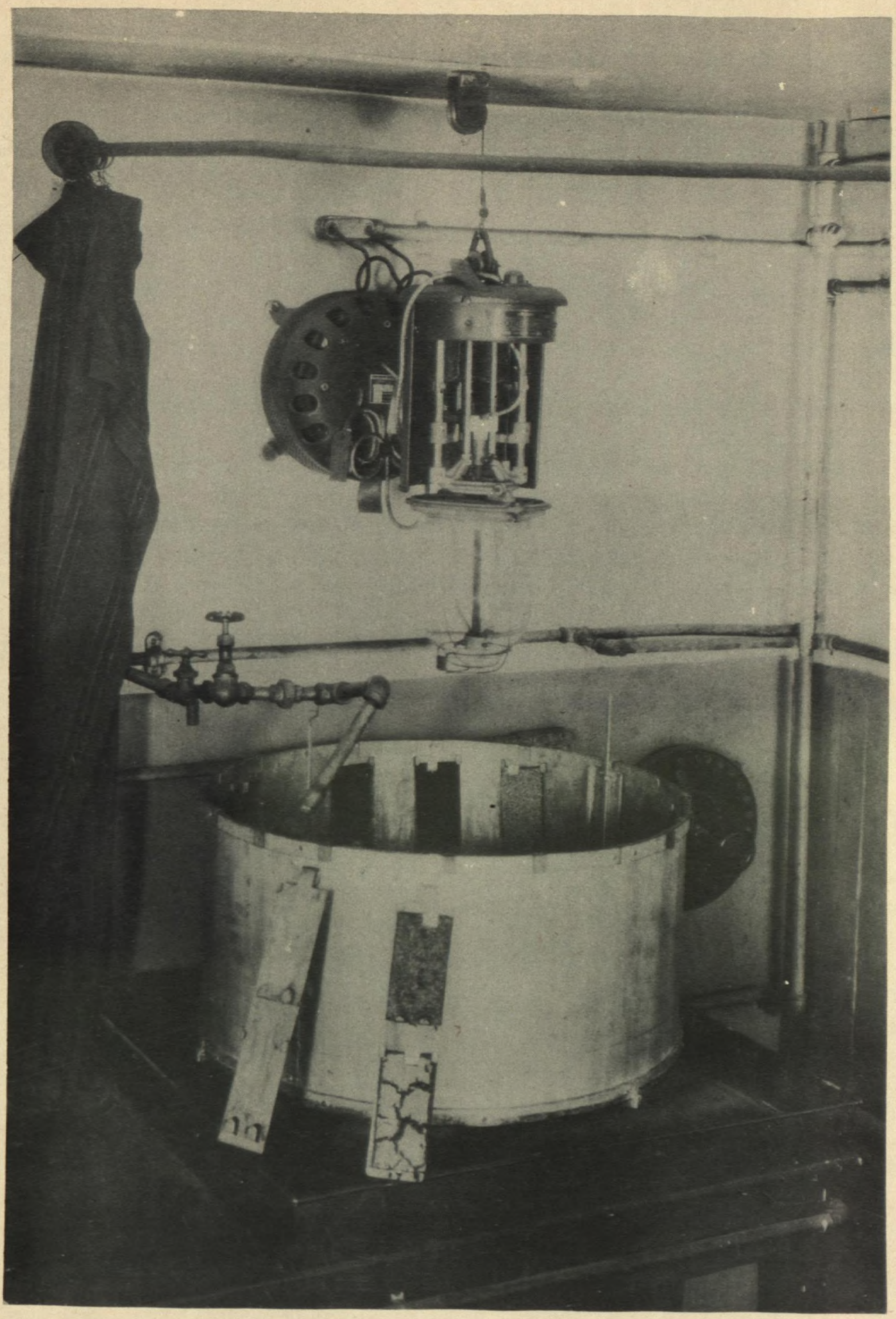


PLATE I.   APPARATUS FOR ACCELERATED WEATHERING TESTS of carbon arc light is used operating at 220 volts d.c. and 13 amperes, which keeps the panels at a temperature of about 110 - 120°F.

The bituminous material that is to be subjected to the weathering test is coated on metal panels, 3 inches wide by 6 inches long to a depth of 1/16 inch. These plates are then placed on the racks in the weatherometer.

The panels are successively exposed to the action of light, water, and cold for a period of 51 days. The light is furnished by the arc lamp, water by means of a rotating lawn sprinkler placed in the bottom of the cylinder after the light is withdrawn, and the freezing effect by removing the panels and placing them in a cold chest where they are cooled by acetone and carbon dioxide snow to a temperature of minus 15°F. Rapid change in temperature rather than prolonged exposure to a low temperature is the purpose of this test.

The weathering cycle adopted is: eighteen hours' exposure to light, three hours' exposure to the water spray, and freezing for one hour every other day. The remainder of the twenty-four hour cycle, namely, two and one-half hours, was required for changing carbons on the arc light and for making other necessary adjustments. This is kept up for 51 days which is considered the equivalent of about 8 to 10 years' exposure to the weather in these latitudes.

Although the indications are that this accelerated weathering test closely parallels actual weather conditions, sufficient data have not yet been accumulated to state this with certainty, nor have any factors been worked out to express any mathematical relation between the two, even in an approximate way. Abraham[5] states that "the indications are that a bituminous substance, to be satisfactorily weatherproof, should withstand the accelerated weathering test from 50 to 80 days without showing signs of cracking through the coating down to the metal panel. Poor weather-resistants will fail within 50 days."

Results Obtained

The different grades of bitumen which were subjected to the accelerated weathering test are shown in Table 6.

TABLE 6

No.7295 - Bitumen from Clarke separation plant, steam reduced to 110°F. S.P. and oxidized to:		No.7921 - Bitumen from International Bitumens, Limited, steam reduced to 110°F. S.P. and oxidized to:	
S.P.	Panel No.	S.P.	Panel No.
141°F.	11	132°F.	15
160°F.	12	141°F.	16
190°F.	13	159°F.	17
219°F.	14	213°F.	18

The panels prepared from these different grades of asphalt were exposed in the weatherometer for 51 days, the operating cycle being as follows:

18 hours light

3 hours water

1 hour refrigeration every second day.

(5) Abraham, H.: Asphalt and Allied Substances, p.850 (3rd Edition).

SAMPLE #7295 (219°F., S.P.)

SAMPLE #7921 (213°F., S.P.)

PLATE II. PANELS AFTER EXPOSURE TO WEATHERING TEST.

In other words, the panels were exposed to

918 hours of light
153 hours of water
26 hours of refrigeration.

The panels were examined at the completion of the tests, and, as a result of this treatment, it was found that the panels prepared from the lower softening point bitumens showed considerable deterioration, the metal backing being exposed at several points. It was difficult to draw any conclusions from an examination of these panels, as, in a good many cases, the bitumen had run off the panels, owing to its comparatively low softening point.

Plate II shows photographs of two panels, after exposure, viz., 219°F. S.P. from sample No.7295 and 213°F. S.P. from sample No.7921. It will be seen that none of them shows "signs of cracking through the coating down to the metal panel", and in that respect may be regarded as satisfactory, but owing to the empirical nature of the weathering test, the results at the present stage indicate the necessity for further work before drawing definite conclusions.

Further Weathering Tests

As already stated, the results of the accelerated weathering tests on the panels described above appeared inconclusive; and in discussing the matter with Mr. Baskin (the asphalt technologist of Imperial Oil, Limited) he gave it as his opinion that the bitumen from which the panels were prepared had been steam-reduced too far before being oxidized to 220°F. S.P., and suggested preparing samples of bitumen, for test purposes, which had had less steam treatment prior to oxidation.

Consequently a 5-gallon sample of bitumen (Sample No.7921) was steam-reduced in the small still to 70°F. S.P. and a 1-gallon sample was drawn off. The remainder was then steam-reduced to a S.P. of 80°F. and a second gallon sample was drawn off. This operation was repeated until bitumens steam-reduced to 90°F. and 100°F. S.P. were obtained. Each of these samples was then oxidized at 450-460°F. until they had reached a consistency of 220°F. S.P.

Test panels were made from these bitumens by coating them to a depth of 1/16 inch on aluminium and bakelite plates. Bakelite panels were used as well as aluminium in order to reduce the cracking caused by the different co-efficients of expansion of metal and bitumen; it being assumed that bakelite and bitumen, both being organic products, would have similar co-efficients of expansion.

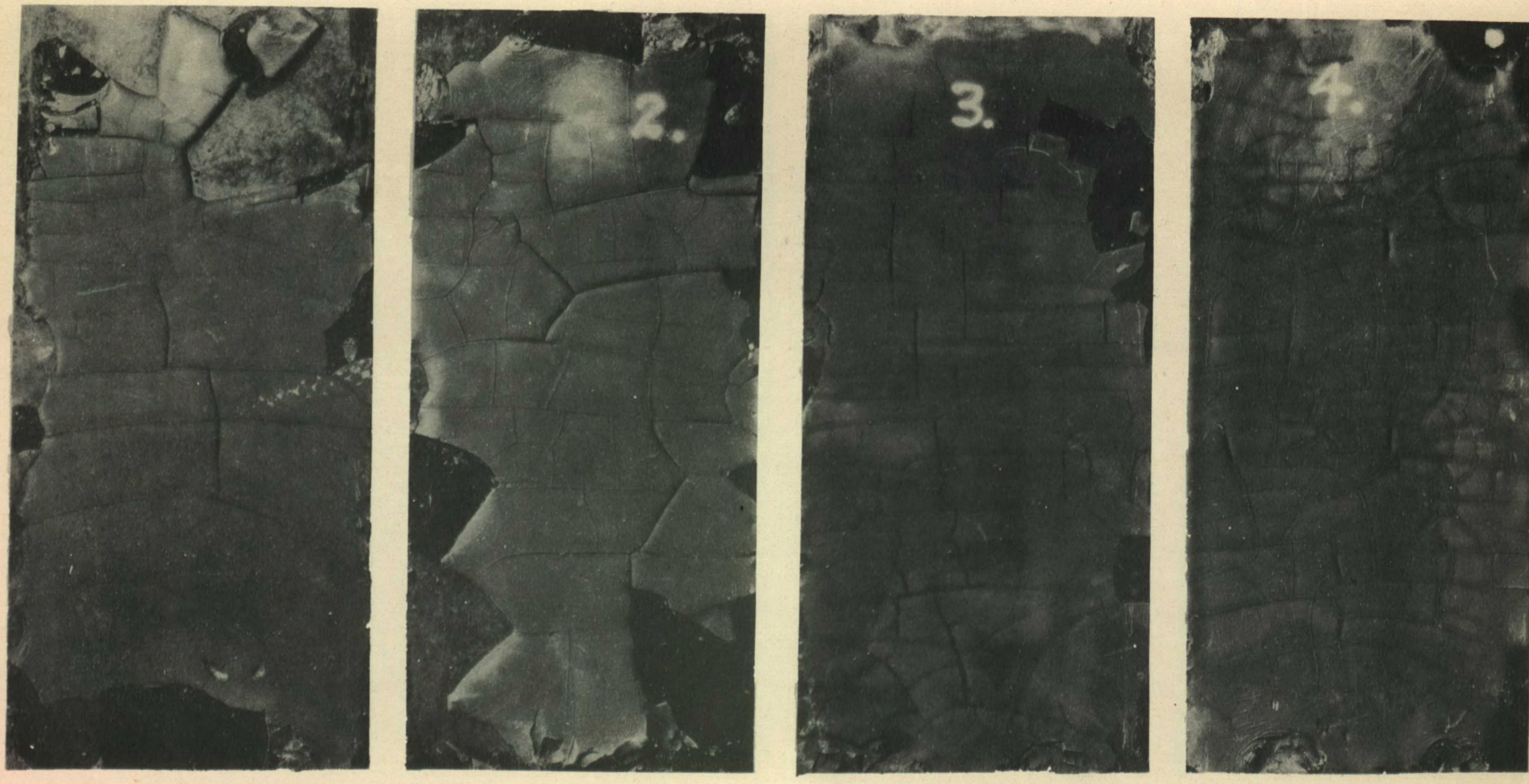
These panels were subjected to the same treatment as those previously described and their condition after exposure is shown in Plates 3 and 4.

Here, again, the results are somewhat inconclusive, but it would appear that steam reduction to 90, or 100°F. softening points, gives the best results and that as a base bakelite is little, if any, superior to aluminium.

<u>SUMMARY AND CONCLUSIONS</u>

(1) Asphalts of different grades were prepared in the laboratory from crude bitumen obtained at two different locations from Athabaska bituminous sands.

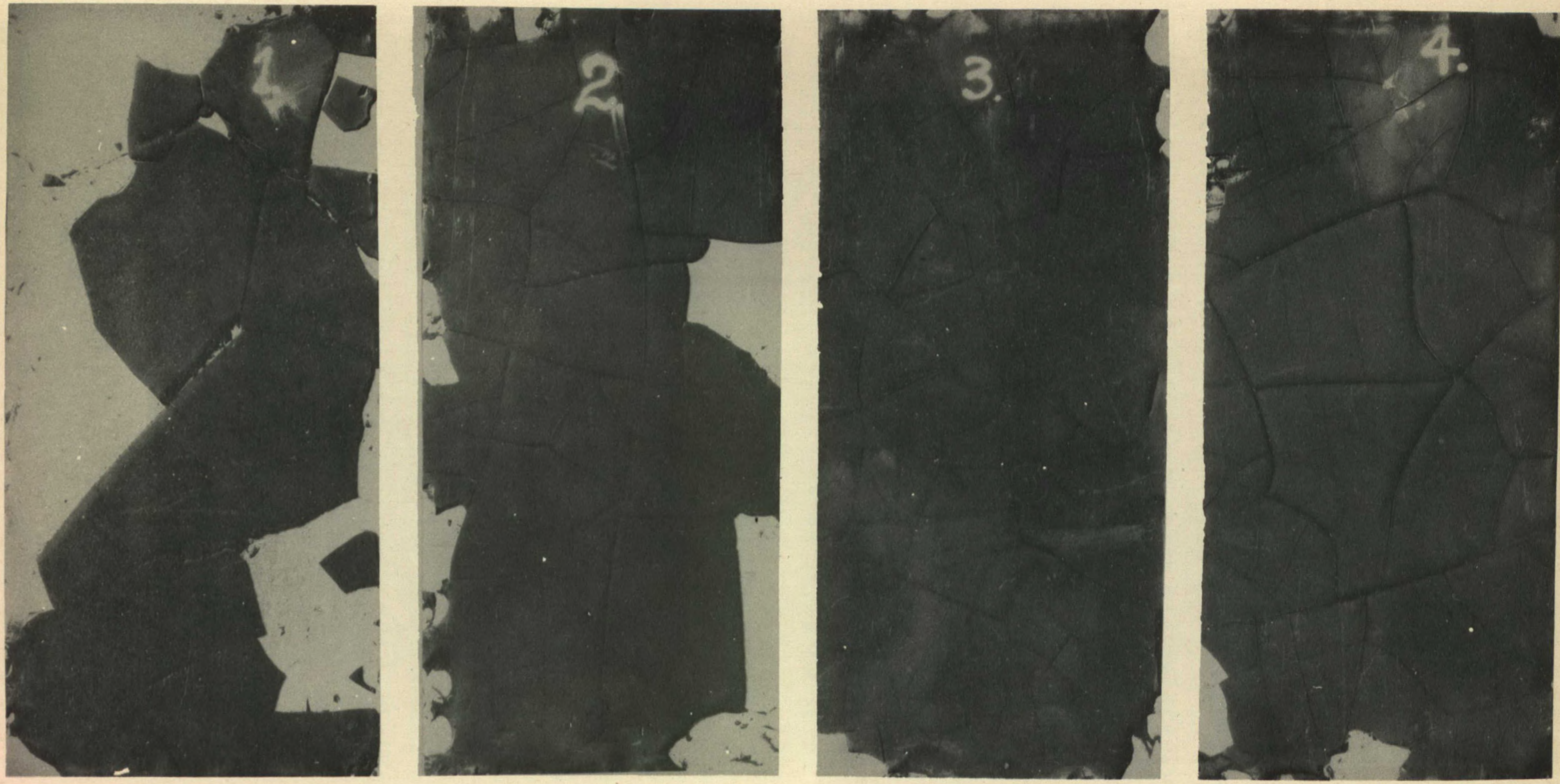
(2) The yields obtained varied from 43 to 91 per cent



S. R. to 70°F. S. R. to 80°F. S. R. to 90°F. S. R. to 100°F.

and blown to 220°F. S.P.

PLATE III. BAKELITE PANELS AFTER EXPOSURE TO WEATHERING TEST.



S. R. to 70°F. S. R. to 80°F. S. R. to 90°F. S. R. to 100°F.

and blown to 220°F. S.P.

PLATE IV. ALUMINUM PANELS AFTER EXPOSURE TO WEATHERING TEST.

of the crude bitumen, depending upon the softening point of the product.

(3) The products were tested by approved analytical methods and the results obtained are given. The results are compared with analytical results for asphalts prepared from crude petroleums produced in different parts of the American continent.

(4) Graphs of some of the main properties of the different grades of asphalt prepared are shown.

(5) Accelerated weathering tests of some of the asphalts on aluminium and bakelite panels were carried out and the results are shown by photographs.

(6) Blown asphalts from Athabaska bitumen are shown to be similar in physical properties to those prepared from various crude oils.

(7) Specifications for asphalts generally call for specific softening points and penetrations. It would appear to be feasible to process Athabaska bitumen to any required consistency and hardness.

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