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THE EUGENE SILICA FOUNDRY SAND

By

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The project:

High-grade silica foundry sand is being produced at Eugene, Oregon, by Silica Products, Oreg., Ltd., and the first shipments were recently made to Portland and Seattle. This company's modern washing and drying plant, financed by the Defense Plant Corporation, is located about a mile north of the deposit which is about 3 miles west of Eugene in the NE¼ sec. 34, T. 17 S., R. 4 W. The deposit forms most of the elongate hill known as Wallace Butte which can be reached via 11th Street.

As the pit material is about two-thirds quartz sand and one-third fire clay with a minor amount of mica, it contains too much bond to be used as a naturally bonded sand. It must be washed and the Silica Products, Oreg., Ltd.'s plant was recently built for this purpose. The flow sheet is shown in the accompanying diagram. The raw sand is loaded at the pit into dump trucks by means of a dragline. It is then trucked to the plant where it is dumped into a hopper with a drag-type conveyor feeder which carries the sand to a log washer. From the log washer the sand goes to a Dorr duplex classifier. The overflow carries off most of the clay and the partially washed sand drops into a long drag classifier, the overflow from which carries off nearly all the remaining clay, though a desirable partial film of clay is left on many of the sand grains. The sand from the drag classifier is elevated to a belt conveyor which carries it to the stockpile. A Scoopmobile transfers the sand from the stockpile to a hopper from which a bucket elevator carries it to the top of the steam drier. As the sand dries, it drops down through a network of steam pipes and is conveyed and elevated to the screening house and storage bins from which it is loaded into railroad cars for shipment. The boilers for the steam drier are heated by coal fed by automatic stokers.

Water for the washing operations is obtained from a large trench dug in porous gravels. The clay removed by the washing operations is refractory and suitable for making fire brick. It is being collected in other large pits which serve as settling ponds. Additional test work on the clay is planned, and as the P.C.E. value of the clay is above cone 31, it may prove to be of considerable economic importance.

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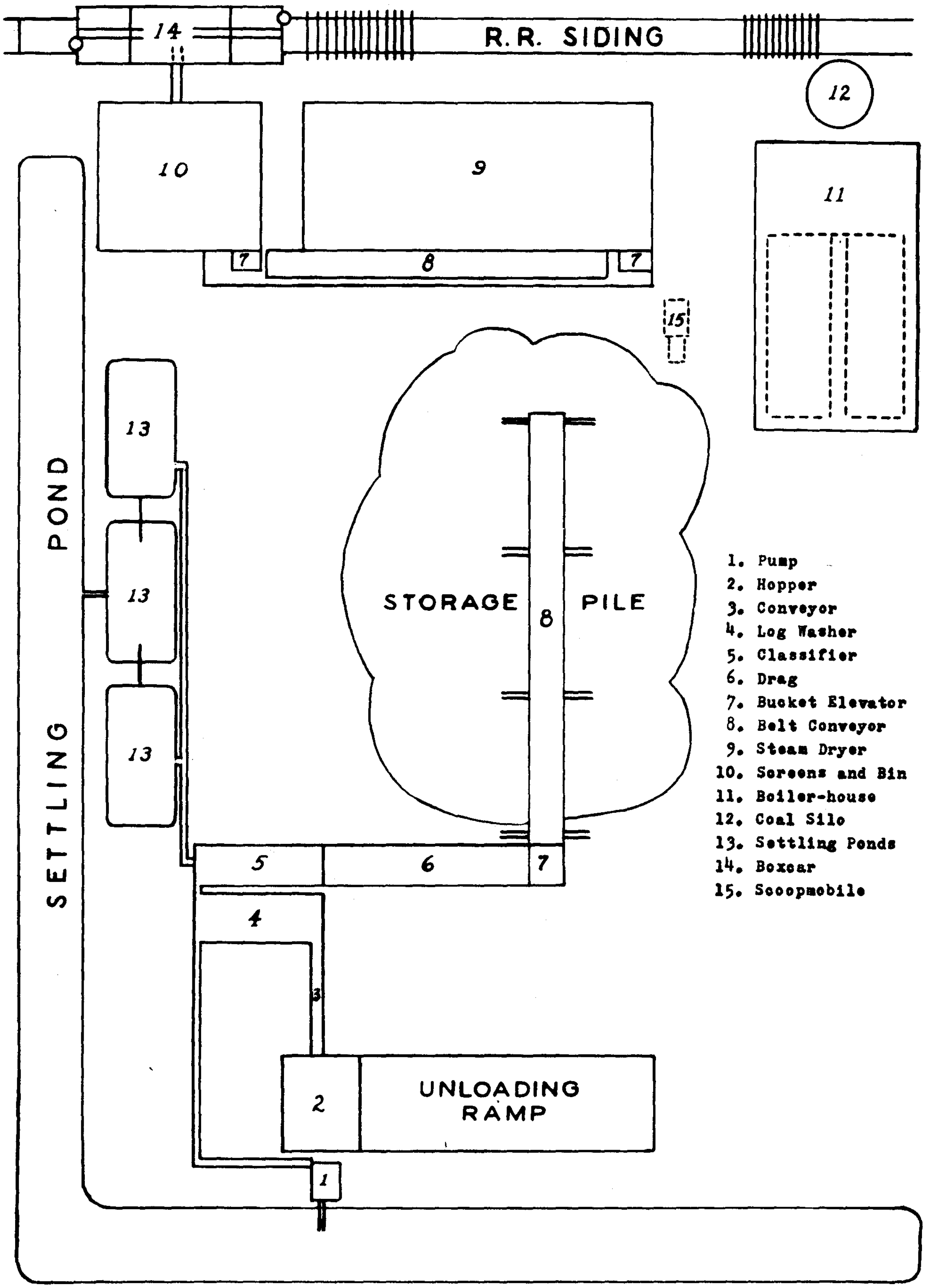
* Associate Geologist, Oregon Department of Geology and Mineral Industries. An abstract of this paper was presented at Geology and Geography Section of Oregon Academy of Science, Portland, Oregon, January 13, 1945.



FLOW SHEET OF SILICA PRODUCTS, OREG., LTD. SAND PLANT, EUGENE, OREGON

History:

The Eugene deposit was first described in 1923 in a report by Paul W. Cook,[1] a geology student at the University of Oregon while the deposit was formerly being worked. The raw sand was then used in the manufacture of no. 2 refractory brick but the deposit was unworked for a number of years prior to acquisition by the present operators. In 1938, Mr. Ray C. Treasher, geologist with the State Department of Geology and Mineral Industries, investigated the deposit and in a preliminary report in collaboration with Mr. Hewitt Wilson of the U.S. Bureau of Mines on some of the refractory clays of western Oregon[2] suggested use of the sand for making glass and for molding in steel foundries.

The raw sand from the pit has been used at various times in the past by foundries but its high clay content makes it rather unsatisfactory until washed. A later report[3] by Treasher in 1943 dealing only with the Eugene deposit led to actual foundry tests conducted at the Crawford & Doherty Foundry, Portland, by the writer and Mr. Ralph Mason, also of the State Department of Geology and Mineral Industries. These tests on the durability of the Eugene sand were very satisfactory and the results were published.[4] Copies of this report and a later memorandum[5] by the writer were sent to most of the Portland foundries. The memorandum discussed the properties of the Eugene sand and compared it with Ottawa Federal 17 which is currently used in many Pacific Northwest steel foundries. War Minerals Report 199[6] was issued in 1944 by the U.S. Bureau of Mines whose drilling in the latter part of 1943 proved several hundred thousand tons of Eugene sand of uniform grade. On the basis of the encouraging results obtained from the various tests and upon the suggestion of H. Ries[7] and the State Department of Geology and Mineral Industries, further foundry tests were made by the Naval Research Laboratory, Washington, D. C. Their tests showed the Eugene sand to be very satisfactory and strikingly similar to one of the leading New Jersey steel foundry sands.

Geology:

As first pointed out by Cook in 1923, it is believed that the Eugene sand is a residual deposit formed by the weathering of an indurated sandstone in the Eugene formation of Oligocene age. A similar clay and sand deposit, known as the Hawkins locality, is about 1 mile southeast of that at Wallace Butte. However, it contains some feldspar grains and compound sand grains which indicate it has not been as thoroughly weathered. This is also indicated by its somewhat lower clay content. The probable parent rock of these sand deposits crops out near the top of the hill immediately south of the Hawkins locality. It is an indurated, massive, light-colored, quartz-feldspar sandstone.

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1 Cook, Paul W., A preliminary report on the geology and economic geology of the Wallace Butte quartz sand deposit, Lane County, Oregon, an appendix to "A preliminary report on the geology of the Eugene quadrangle, Oregon," by H. G. Schenck, master's thesis, University of Oregon, 1923.

2 Wilson, Hewitt, and Treasher, Ray C., Preliminary report on some of the refractory clays of Western Oregon, Bull. no. 6, Oregon Department of Geology and Mineral Industries, 1938.

3 Treasher, Ray C., Preliminary report on a possible molding or glass sand, Oregon Department of Geology and Mineral Industries, 1943, unpublished.

4 Lowry, W. D., and Mason, R. S., Eugene sand foundry tests, Oregon Department of Geology and Mineral Industries, 1943.

5 Memorandum on steel foundry sand at Eugene, Oregon, Oregon Department of Geology and Mineral Industries, 1944.

6 Silica sand deposits in the Eugene area, Lane County, Oregon, U.S. Bureau of Mines War Minerals Report 199, 1944.

7 Personal communication.

Reconnaissance geologic mapping by the writer in the southern part of the Eugene quadrangle, where these deposits are located, indicates that these sands occur at or near the base of the Eugene formation where they disconformably and possibly unconformably overlie the Fisher formation of older Oligocene or Upper Eocene age. Both strike approximately northwest and dip several degrees to the northeast. The presence of fossil wood near the contact with the underlying tuff breccias of the Fisher formation as well as field relationships indicate that these sands were laid down when the Eugene (Oligocene) sea first invaded the region. The uniform grain size of the sand suggests that it may have been derived from nearby older sandy formations such as the Spencer or Tyee of Eocene age, which in turn may have been derived from the old Klamath Mountain highland. Such reworking plus possible transportation by wind to form dunes, as suggested by field observations, may explain the unusually uniform grain size of the Eugene sand.

Foundry sand use and properties:

People not connected with the industry do not realize the importance of foundry sand which is used to make the forms in which metals are cast. A wide variety of foundry sands are employed to make the multitudinous steel, gray or cast iron, bronze, brass, and aluminum castings.

Foundry sands may be divided into molding sands and core sands. The former are used for making the molds whereas core sands are used to form the hollow portions of castings. The sands also may be divided into naturally bonded and synthetic sands. The naturally bonded sands contain a relatively small percent of clay (5-20 percent) which binds the sand grains together. Synthetic sand, whose use is increasing, is a "sharp" sand with added clay, fire clay, bentonite, or a mixture of these which binds the grains together. A "sharp" sand, according to foundrymen, is one without bond. Molding sand can be re-used and can be employed as long as the properties of the sand remain satisfactory. New sand and additional bond often can be added to the old or used sand to build it up and thus further lengthen its life. Today a number of the larger foundries have special equipment to reclaim part of the used sand by washing and screening. "Sharp" sand is used in making cores, and as they must withstand the greatest heat and stress, special binders such as resin, pitch, oil, or various cereals are added and then the cores are baked in drying ovens. After one use the cores are thrown away.

As outlined by Ries,[8] the five important properties of a foundry sand are fineness, bonding strength, permeability, sintering point, and durability. Fineness relates to the size of the sand grains. Although degree of fineness exerts an influence on such properties as the permeability and bonding strength of the sand, probably the most important effect of fineness is on the smoothness of the casting. Within certain limits, the finer the sand, the cleaner the casting. Bonding strength refers to the strength of the sand mixture. Although the amount of clay or other bond largely determines the strength, the amount of moisture added and the shape of the sand grains are also important factors. Permeability is the property of the sand that permits the passage of gases, and is necessary for the proper venting of the gases generated during the pouring of the casting. Permeability is related to porosity and is calculated by measuring the rate of flow of air through a standard cylinder of the sand mixture. Although fine sands tend to have low permeabilities and coarse sands, high permeabilities, the uniformity of the grain sizes of a sand is an important factor in determining this property. The sintering point is the temperature at which fusion begins. The most siliceous sands are most refractory. The durability, or life, of a molding sand mixture is determined by its ability to regain most of its green (wet) strength when water is again added to it after it has been used once. Thus the durability of a sand mixture depends largely on the nature of the binder in a naturally bonded sand or on that added to a synthetic sand.

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[8] Ries, H., Special Sands, Chap. XLI of Industrial Minerals and Rocks, A.I.M.E., New York, 1937.

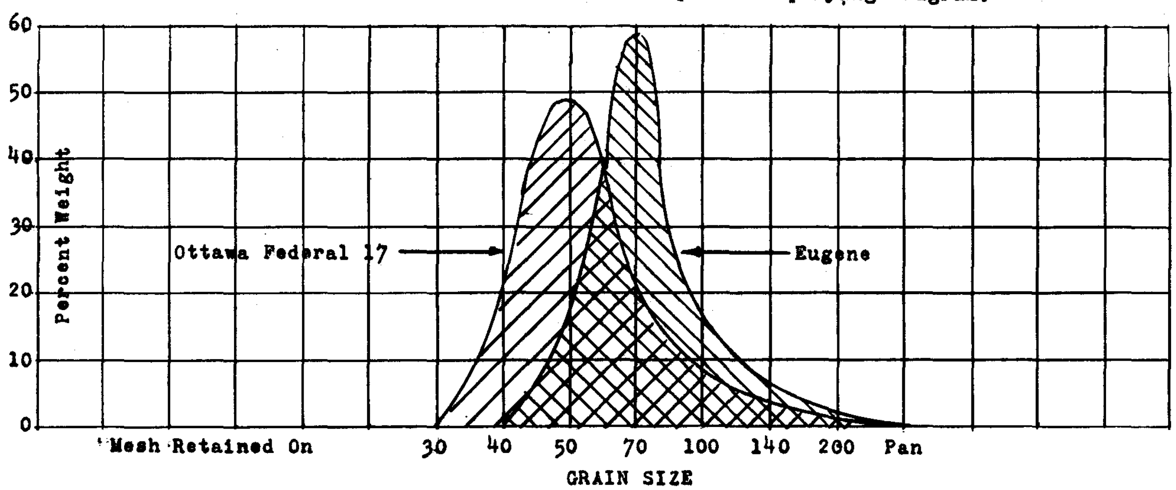
Although formerly most of the testing of foundry sand mixtures before making the molds and cores was done by an experienced foundryman who could tell by "feel," today many of the foundries have a special laboratory equipped for this testing. The various equipment includes apparatus for measuring the moisture content, the green (wet) permeability, the green strength, the dry permeability, the dry strength, the flowability, and the mold hardness of various sand mixtures.

Much of the silica sand supplied to the Pacific Northwest steel foundries comes from the Ottawa, Illinois, district where it is obtained from the St. Peter sandstone of Ordovician age. California and Nevada produce some silica sand but little reaches the Northwest. Although many sands in Oregon and the western United States can be used for gray or cast iron molds which must withstand temperatures generally below 2600° F., only a few can withstand the higher temperatures (2600° - 3000° F.) to which semi-steel and steel molding sands are subjected. To withstand these higher temperatures, the sand must be made up of only refractory mineral grains. Of the more common sand minerals, quartz is the only satisfactory one. Most Oregon sands contain a high percentage of feldspar grains which fuse at the temperatures at which steel is poured and thus they cannot be employed in steel foundries. Some research has been done on the use of crushed olivine as a foundry sand but as only the high magnesium varieties of olivine, $(Fe, Mg)_2SiO_4$, are highly refractory and as they are relatively uncommon, the work has not resulted in any known commercial use. However, as Oregon and Washington are two of the few states where olivine-rich rocks occur, it is possible that further field investigation will discover high magnesium olivine deposits near enough to transportation to become of commercial interest.

Characteristics of Eugene sand:

The Eugene sand is one of the few high-grade steel foundry sands being produced in the western United States and is the only one in Oregon.

The properties of the Eugene sand for steel foundry use are somewhat similar to those of the Ottawa sand. The Eugene sand is somewhat finer than the Ottawa Federal 17 grade and as already mentioned, the report by the Naval Research Laboratory, Washington, D. C., notes that the Eugene sand is strikingly similar in fineness and other properties to a sand from the Millville area of New Jersey which is used extensively by steel foundries in the East Coast region. The report further noted that both of these sands are somewhat coarser than the average sand used for steel moldings in eastern foundries. The trend of foundry practice in the East appears to be toward the employment of finer sands. In spite of its somewhat finer grain size, the permeability of the Eugene sand is nearly equal to or greater than that of Ottawa Federal 17. This is attributable to its greater uniformity of grainsize as illustrated in the accompanying diagram.



Ottawa Federal 17 is a product of screening whereas the Eugene sand is naturally graded. The possible explanation of the surprising uniformity of the grain sizes of the Eugene sand is mentioned on page 12. Unlike the rounded grains of the Ottawa sand, those in the Eugene deposit tend to be subangular and like those of the leading East Coast sands.

Apparent advantages of the Eugene sand over the Ottawa Federal 17 are that it permits the use of a finer sand without loss of permeability, which makes for cleaner castings; also the Eugene sand makes a stronger mold, as its subangular grains tend to interlock, whereas the rounded grains of the Ottawa sand do not. Actual measurements gave greater strength values for the Eugene sand, and its dry shear strength value was more than twice as great as that of the Ottawa. The partial film of clay left on many of the Eugene sand grains after washing is probably partly responsible for this greater strength.

A recent report by Mr. Roy Simpson, foundry foreman of the Oregon Steel Foundry, on tests conducted by them on the Eugene sand follows:

> Base test on straight run of Eugene silica sand was 200 permeability which was too high for the 10,000-pound gear blank on which the test was to be made. By the addition of 75 pounds of banding sand and 150 pounds of silica flour the permeability was lowered to 140 which was considered about right for the test casting.

Final Mixture

1000	lb.	Eugene sand
75	lb.	Banding sand
150	lb.	Silica flour
6	gal.	Corn flour
4½	gal.	Bentonite
4½	gal.	Fire clay

Final Green Sand Specifications

Moisture	5.1 %
Permeability	140
Green compression strength	7.5

After air drying for 4½ hrs. the green comp. strength was raised to 14.4. No test on the dry shear was made.

> Type of test casting - 10,000 pound gear blank cast steel. Condition of mold before pouring: Excellent. Fine surface. Good and firm. Observations made through large shrink head while pouring. Molten metal did no cutting or scabbing on mold surface while being poured. In general the mold surface exhibited great hot strength, a quality greatly desired in the steel foundry. The mold gases generated while pouring seemed about the same as the Ottawa sand and were readily exhausted in the usual manner.

> After the casting had cooled the sand broke away or peeled off very easily, or just as good as the Ottawa sand. After the casting was sandblasted the amount of sand found burned in next to the heavy fillets on the casting was found to be less than the usual amount on the Ottawa sand casting.

> We have made over 75 of these large steel castings and we can say that the Eugene sand used on this test gave us the least of all in cleaning time in regard to sand that is usually found burned in or fused together due to the great heat that a molding sand must stand up under.

/s/ Roy Simpson
Foundry foreman

Conclusion:

The Eugene sand is being marketed in Portland at $8.75 a short ton. Ottawa Federal 17 sells for about $11. The price favors the use of the Eugene sand in the Portland area, and as all the testing work done to date has been very encouraging, it appears that the Eugene silica sand not only will be widely employed in the Portland area but elsewhere on the Pacific Coast as well.

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MIRACLE BATTERY USES MERCURY*

Tiny but incredibly powerful dry batteries which use mercury as a prime component are now helping win the war in the Pacific. Walkie-talkies and mine detectors are using the new midget-sized long-life cells. One size of the revolutionary cells measures only three-eighths of an inch long but develops as much power as a standard sized flashlight battery, and runs five times as long.

The impact of the new use for mercury is reflected in the upward surge in market quicksilver quotations. Some months back flasks of the metal were quoted at less than $100 but market price has now risen to $165. To supply the sudden demand for mercury the Metals Reserve Company has released supplies from its stockpile.

The new battery was invented by M. S. Ruben, an electro-chemist of New Rochelle, New York. Manufacturing rights are held by the P. R. Mallory Company, Indianapolis, which worked in close cooperation with the Army Signal Corps. Although not available yet for general civilian use the postwar possibilities are tremendous, especially where size and weight are important. More expensive to manufacture than the familiar dry cell, the new mercury cell will nevertheless find much use where longevity, bulk, and performance in tropical conditions are critical factors. Some experts predict that as much as 50 percent of postwar mercury production will go into the new batteries, and that the former peace time demand will be doubled.

The present type of dry cell is not destined to a postwar demise, however. Larger units of the old style battery are superior to the mercury unit, and the old cells function better in subzero temperatures.

Suggested uses for the midget batteries are power units for hearing aids, portable battery radios and close-range short-wave radios. Aside from the visible disparity in sizes, the "new" and "old" batteries differ greatly in their composition and structure. The old type battery is encased in a zinc can filled with a mixture of sal ammoniac and manganese dioxide, with a carbon rod in the center for a positive pole. The mercury battery is enclosed in a steel container which is its positive pole. A coil of impregnated layers of paper and zinc surrounded by mercuric oxide fills the unit and an insulated zinc pellet at one end serves as the negative pole. The old battery cannot be packed in airtight since it "breathes" through its walls. The new cell is hermetically sealed and can be tightly packed. The new cells have turned out 93.6 volts from a space 1½ inches in diameter and less than 12 inches long, into which 72 units had been placed.

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* Abstracted from the Pacific Coast Edition of the Wall Street Journal, January 19, 1945.

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MERCURY IN DECEMBER 1944

The following monthly mercury report was released by the U.S. Bureau of Mines on February 12, 1945.

Salient statistics on mercury in the United States in 1939-44 in flasks of 76 pounds each

Period	Production	Consumption	Stocks at end of period: Consumers and dealers 1/	Stocks at end of period: Producers 2/	Price per flask at New York
	Average Monthly				
1939 . . .	1,553	3/ 1,742	12,600	376	$ 103.94
1940 . . .	3,148	2,233	14,100	607	176.87
1941 . . .	3,743	3,733	12,400	439	185.02
1942 . . .	4,237	4,142	10,700	1,377	196.35
1943 . . .	4/ 4,327	4,542	13,200	3,457	195.21
	Monthly				
1944:					
January .	4,400	3,400	11,300	5,459	151.60
February	3,800	3,700	9,400	5,450	130.00
March . .	3,800	3,600	9,900	5,011	130.00
April . .	3,700	3,200	9,700	5,604	128.20
May . . .	3,400	3,100	8,900	6,171	115.54
June . .	3,000	3,400	9,000	5,757	101.69
July . .	2,700	3,000	9,300	4,025	100.56
August .	2,500	3,900	9,100	2,252	104.04
September	2,500	3,900	8,400	1,936	104.28
October .	2,700	3,900	7,400	2,550	109.20
November	2,300	3,900	7,800	2,094	116.30
December	2,500	3,900	10,400	2,714	128.88
Total	37,300	42,900	----	----	5/ $ 118.36

1/ Largely excludes redistilled metal. 2/ Held by reporting companies. 3/ Apparent consumption. 4/ Based on final figures. 5/ Average.

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LIME PLANT REPORTED CLOSED

The lime plant of the Washington Brick and Lime Company at Williams has been closed, according to a report in the Grants Pass Courier of February 14. It is stated that the shutdown became necessary mainly because of lack of manpower, as most of the employees have been drafted. A secondary reason reported was that machinery replacements are required, which would be greatly delayed in delivery.

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