March 22, 1949

Dr. George Calingaert,
Ethyl Corporation,
1600 W. Eight Mile Road,
Ferndale 20, Detroit, Mich.

Dear Cal:

I am sending you herewith a report sent to me by Mr. VanHartesveldt of Thompson Products, Incorporated. The report will be self explanatory, I believe, but, in intent, it represents an attempt on the part of Mr. VanHartesveldt and his associates to appraise the practical significance of the evaporation of tetraethyl lead from their product. The data and their interpretation should be considered against the background of the work done in your Laboratory on this problem.

I should appreciate it very much if you would look this over critically and let me have your considered judgment as to its validity in relation to the practical problem presented.

Sincerely yours,

Robert A. Kehoe, M. D.

RAK ef

Enc.

A. T. COLWELL, President JOHN N. COLE, Vice President C. H. VAN HARTESVELDT, Vice President

Thompson Vita-Meter Corporation

A WHOLLY-OWNED SUBSIDIARY OF THOMPSON PRODUCTS, INC.

23555 EUCLID AVENUE

Cleveland 17, Ohio

PLEASE DIRECT REPLY TO
C. H. VAN HARTESVELDT
6402 CEDAR AVENUE
CLEVELAND 3, OHIO

March 18, 1949

Robert A. Kehoe, M. D.
University of Cincinnati
Kettering Laboratory of Applied Physiology
Eden Avenue
Cincinnati 19, Ohio

Dear Dr. Kehoe:

Enclosed are two copies of a report on relative evaporation rates of tetraethyl lead from gasoline and Vitol. At rates of evaporation comparable to that expected from open containers and transfer from one container to another, tetraethyl lead evaporates from Vitol between 1.1 and 2.3 times as fast as from gasoline. This comparison was determined for the amount of tetraethyl lead evaporated with the first 10 to 23% of gasoline evaporated. As additional gasoline and Vitol evaporated, the rate of lead evaporation from Vitol increased to 3.5 to 5 times as fast as gasoline. However these latter rates are through a range of total evaporation less significant because attendant waste and fire hazard bring a correction of the condition for commercial reasons.

I will appreciate your sending one of the copies to the proper person at the Ethyl Laboratories because I do not consider realistic their report showing lead evaporation from Vitol to be one hundred times faster than from gasoline. Their report has been made available to other oil companies who have asked my viewpoint but I would prefer to have an interpretation of all the data come from you.

As we prepare for the Cincinnati effort it will be helpful to have the area in which Vitameters and Vitol will be sold defined precisely. I would like to call in Cincinnati at your convenience to discuss this matter along with a general consideration of tentative schedules for subsequent expansion of our sales area in the event that all results continue to be favorable. I could come on Friday, March 25th and will await your advice on whether or not this date suits you. If it does not, I will be glad to have you suggest a time.

With all best wishes,

Cordially yours,

C. H. Van Hartesveldt

C. H. Van Hartesveldt

CHV:sg
cc: A. T. Colwell

A STUDY OF THE RELATIVE EVAPORATION RATES OF TETRAETHYL LEAD FROM GASOLINE AND VITOL

A study of the relative evaporation rates of tetraethyl lead from gasoline and Vitol was undertaken in an attempt to determine the relative amounts of lead vapors given off during constant exposure of the solutions to the air.

It is known that the evaporation rate of tetraethyl lead from gasoline is relatively low until approximately 1/2 of the gasoline evaporates with a gradual though not sharp increase thereafter. For a homogeneous single phase solution with one component of relatively low vapor pressure, this would be true as the molar concentration of the low vapor pressure component must be increased to cause an increase in its relative evaporation rate.

The presence of two insoluble, immiscible liquids in Vitol presented the questions applicable to a two-phase solution. Since the individual or combined vapor pressures of alcohol and water in the molar concentrations of Vitol were less than that of gasoline, it seemed feasible to investigate the evaporation of tetraethyl lead from Vitol during the early stages of exposure. If the individual or combined vapor pressures were low, relative to the vapor pressure of tetraethyl lead, the initial evaporation rate of tetraethyl lead would be high regardless of the phases. If there were a suitable balance between the vapor pressures, evaporation of the tetraethyl lead could, quite possibly, be gradual enough to eliminate the possibility of a large concentration of tetraethyl lead vapors at any point during the evaporation of Vitol.

In order to determine the amounts of liquid and tetraethyl lead evaporating during given time intervals and under similar conditions, samples of Blue Sunoco gasoline and Vitol with 3 cc. per gallon of tetraethyl lead were placed in 600 ml. beakers and set side by side in a standard laboratory fume hood. At the time intervals indicated in the data, the volume of the solution was measured and a 50 ml. sample withdrawn for tetraethyl lead analysis. The volumes and time intervals used were optional, but preliminary investigation had indicated that satisfactory curves could be prepared.

All percentage calculations are based on the use of 500 ml. of solution with 3 cc. per gallon of tetraethyl lead (i.e. "% of solution evaporated" is that per cent of total solution which has evaporated, and "% of tetraethyl lead evaporated" is that per cent of the total tetraethyl lead content which has evaporated).

The data for test "a" was collected by evaporating in a fume hood with two exhaust vents open. The volume of the solution at each time interval was obtained by weighing the solution in the container and determining the specific gravity of the solution with a Westphal balance. The tetraethyl lead analysis for this and all subsequent tests was run in strict accordance with A.S.T.M. Designation: D526-42 A.S.T.M. Standards, 1946.

The data for test "b" was collected in order to obtain some information not available in the first test and to determine the effect of some procedure variations on the final conclusions. In order to more nearly simulate actual evaporating conditions in the field, one of the exhaust vents of the fume hood was closed, thus greatly reducing the air circulation and accounting for the lower evaporation rates. The volume of the solution was obtained by passing the solution into a graduate calibrated in one ml. intervals. The temperature, taken at each time interval, was 25.5° C. ± .5°.

The purpose of the tests used to prepare Graph 4 was to amplify that portion of the curve between the start of the evaporation and the 2-1/2 hour reading. No tetraethyl lead determinations were made since the rate of tetraethyl lead evaporation with respect to solution evaporation can be determined from the preceding Graphs.

Blue Sunoco gasoline used in these tests was obtained from the Thompson Products Dynamometer laboratory and is covered by the attached certificate of analysis. The Vitol used was that currently being used in the field. The Gulfpride gasoline used in the test for Graph 4 was obtained from the Thompson Products Dynamometer laboratory and was found to contain 2.37 ml. per gallon of tetraethyl lead.

Conclusions

A. Under the more rapid evaporating conditions --
   1) Gasoline evaporates from approximately 3.2 times as fast as Vitol in 2-1/2 hours to approximately 1.4 times as fast in 22 hours.
   2) Initially, for every one per cent of liquid evaporated, approximately 1.4 times as much lead volatilizes from Vitol as from gasoline under the same conditions.
   3) Lead evaporates approximately 1.1 times as fast from Vitol as from gasoline in 2-1/2 hours and approximately 3.5 times as fast in 22 hours.

B. Under the slower evaporating conditions --

1) Gasoline evaporates from approximately 1.9 times as fast as Vitol in 2-1/2 hours to approximately the same rate in 22 hours.
2) Initially, for every one per cent of liquid evaporated, approximately 2.8 times as much lead volatilizes from Vitol as from gasoline.
3) Lead evaporates approximately 2.3 times as fast from Vitol as from gasoline in 2-1/2 hours and approximately 5 times as fast in 22 hours.

Respectfully submitted,

THOMPSON PRODUCTS, INC.

C. C. Clark
Assistant Chief Chemist

APPROVED BY:

K. M. Bartlett

Table 1

Rate of Lead Tetraethyl Evaporation

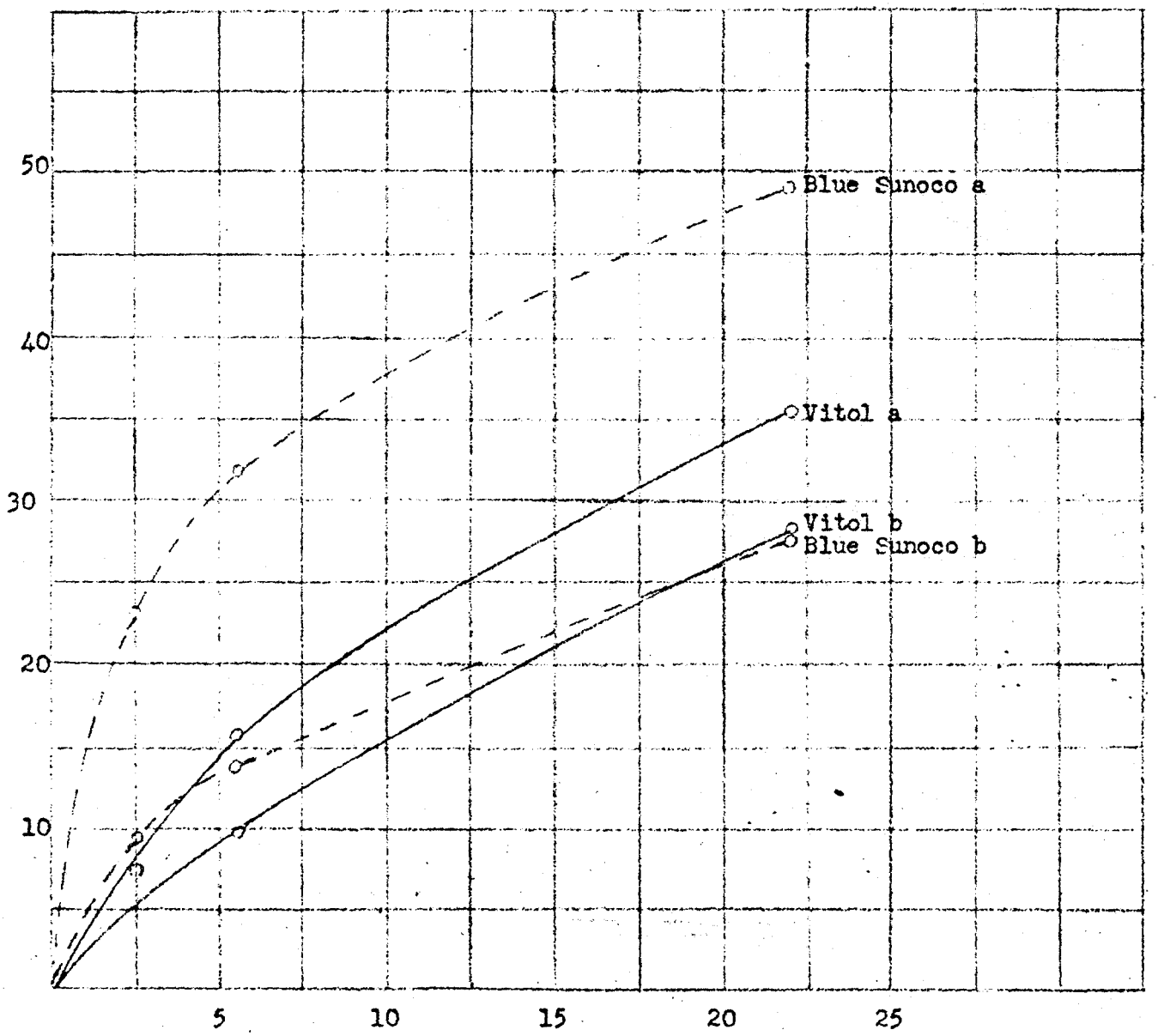
	ml. of lead tetraethyl	ml. of lead tetraethyl evaporated	% of lead tetraethyl evaporated
Vitol (test "a")			
Start	.212		
2-1/2		.040	18.8
5-1/2		.050	23.6
22		.118	55.7
Vitol (test "b")			
Start	.262		
2-1/2		.021	8.0
5-1/2		.032	12.2
22		.093	35.5
Blue Sunoco (test "a")			
Start	.370		
2-1/2		.054	14.6
5-1/2		.059	16.0
22		.059	16.0
Blue Sunoco (test "b")			
Start	.375		
2-1/2		.013	3.5
5-1/2		Analysis lost in process	
22		.027	7.2

Table 2

Rate of Solution Evaporation

	ml. of solution	ml. of solution evaporated	% of solution evaporated
Vitol (test "a")			
Start	435		
2-1/2		32	7.3
5-1/2		68	15.6
22		152.5	35.2
Vitol (test "b")			
Start	450		
2-1/2		23	5.1
5-1/2		44	9.8
22		127	28.2
Blue Sunoco (test "a")			
Start	433		
2-1/2		100	23.1
5-1/2		141	31.8
22		212	49.0
Blue Sunoco (test "b")			
Start	450		
2-1/2		42	9.3
5-1/2		62	13.8
22		124	27.6

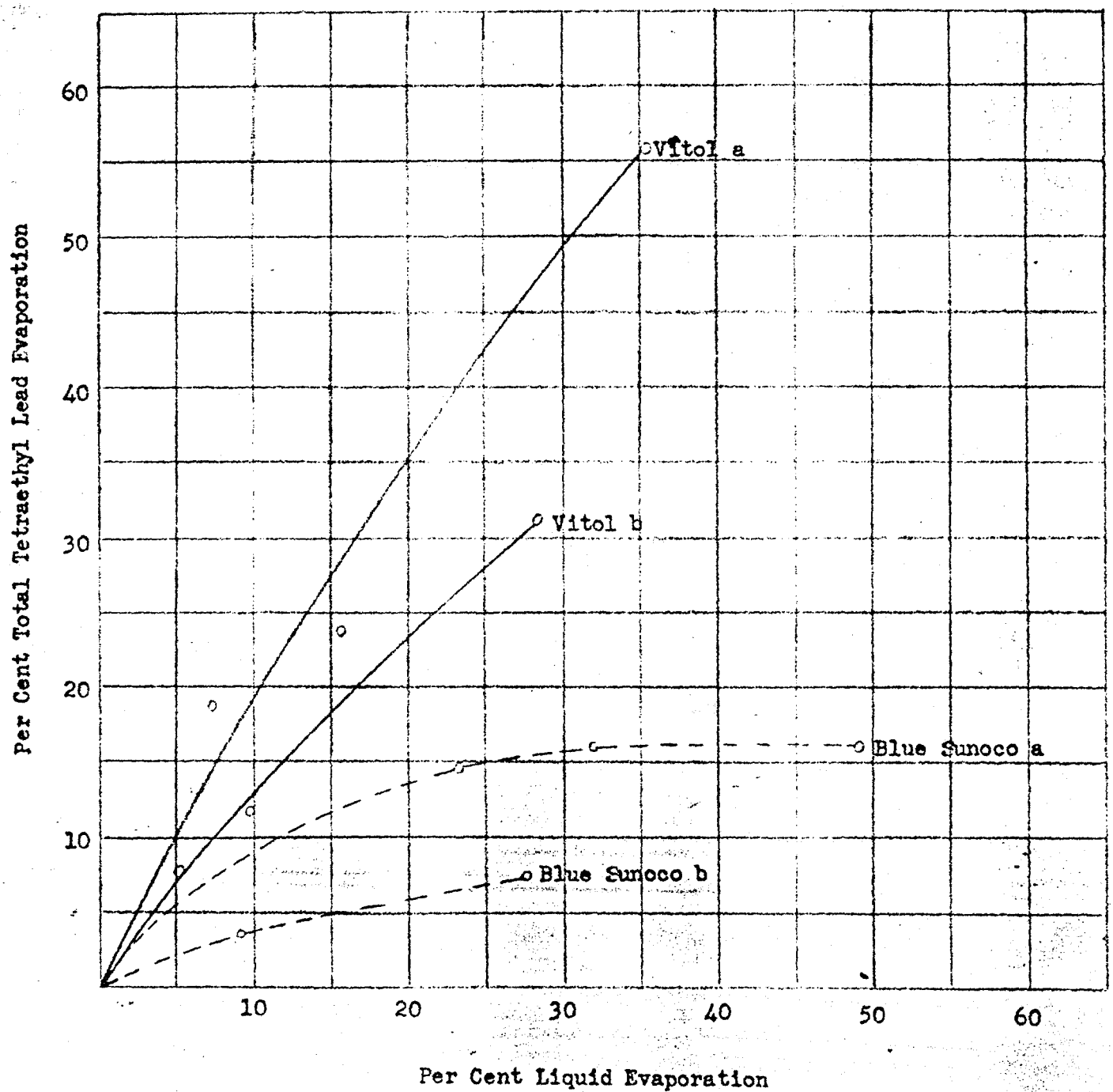
Rate of Liquid Evaporation Curve



Time in Hours

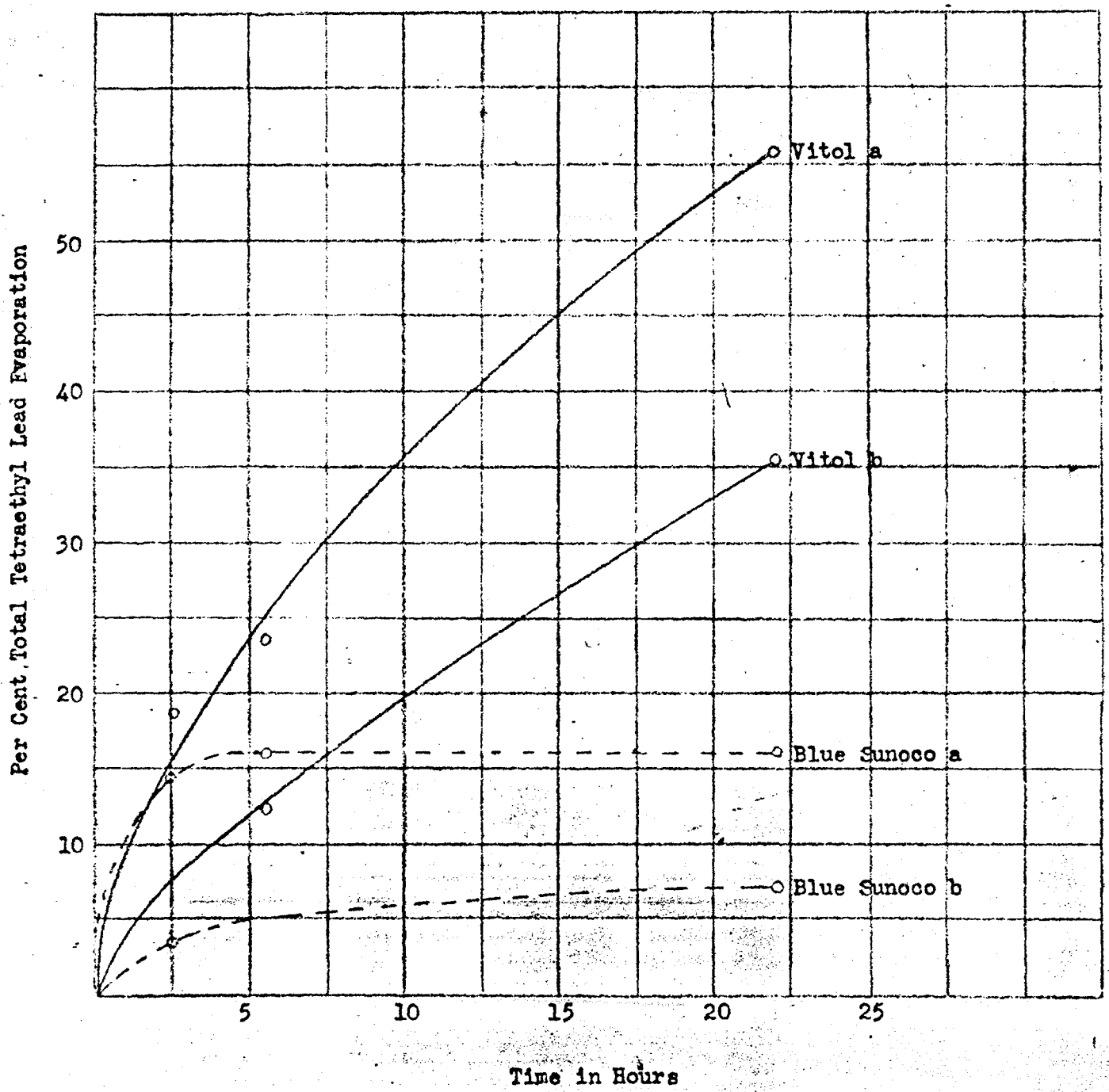
KE 0020635

Per Cent Tetraethyl Lead Evaporation
vs. Per Cent of Liquid Evaporation Curve

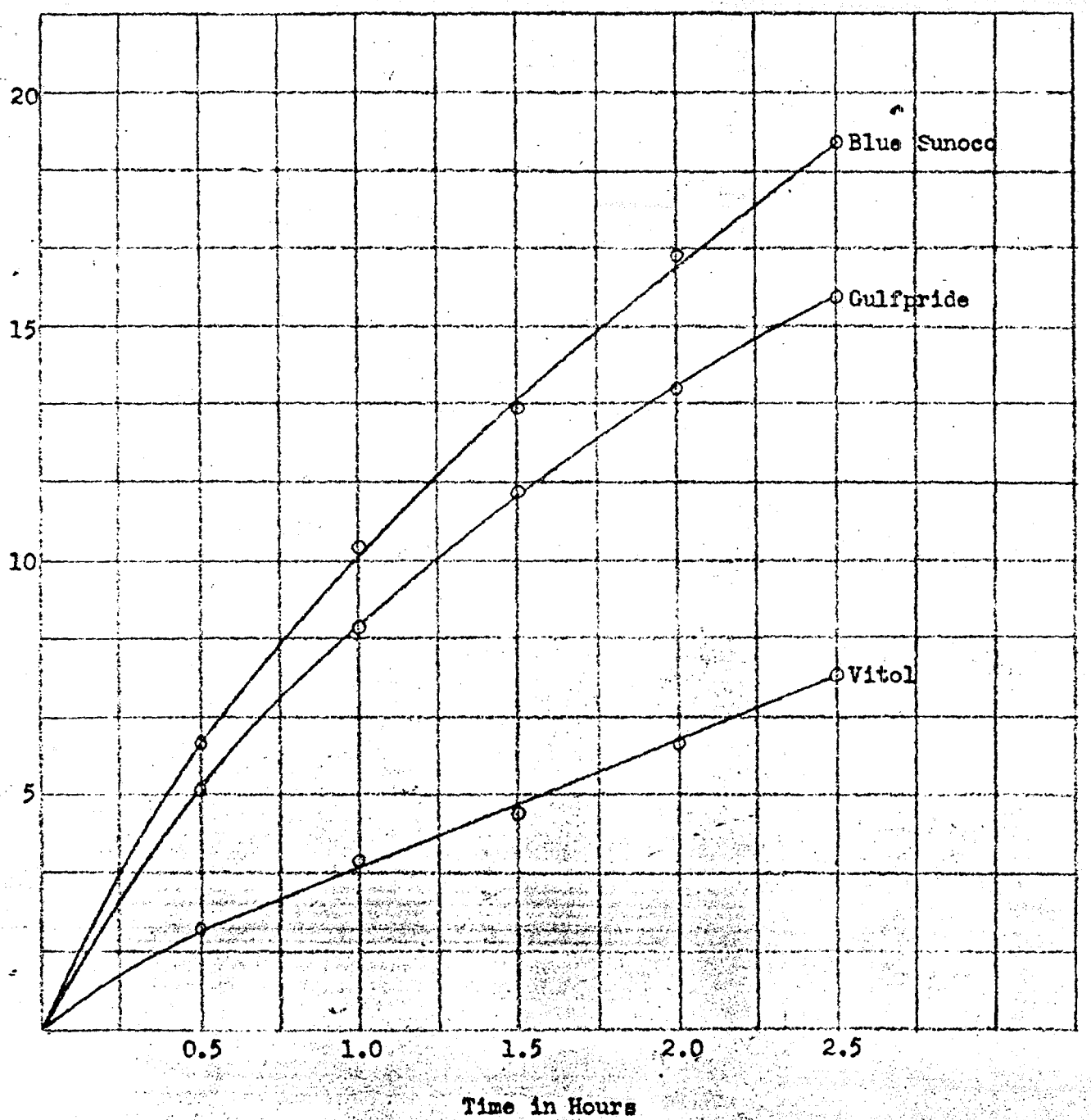


KE 0020636

Tetraethyl Lead Evaporation
from Vitol and Gasoline



Rate of Liquid Evaporation Curve #2



KE 0020638

SUNOCO DYNAFUEL — WINTER GRADE

Authority
CHT:AWM

11/18/48

Specifications

Gravity - A.P.I./60° F.	Approx. 56.0 - 63.0
Distillation - A.S.T.M.	
10% Evaporated	105 - 125° F.
50% Evaporated	205 - 235° F.
90% Evaporated	365° F. Max.
Recovery	95.0% Min.
Residue	2.0% Max.
Sulphur - A.S.T.M.	0.08% Max.
Gum - Copper Dish	8 mgs. Max.
Gum - A.S.T.M.	2.0 mgs. Max.
Copper Strip - A.S.T.M.	Pass
Color	Blue
Octane F-1	84.0 - 86.0
Octane F-2	76.5 Min.
Reid Vapor Pressure / 100° F.	13.5 Max.
Induction Period	6 hours Min.

Effective December 1 to February 28