

ESSO STANDARD OIL COMPANY
BATON ROUGE REFINERY
Mechanical Technical Service Department



INSULATION STUDY

This study covers a comparison of four insulations for hot service piping. The products considered were:

Careytemp	Philip Carey Manufacturing Company
Kaylo	Owens-Corning Fiberglas Corporation
Thermobestos	Johns-Manville
Unibestos	Union Asbestos & Rubber Company

This study is divided into two parts. Part I consists of published physical properties. Part II consists of tests and observations made in the MTS Laboratory and out in the Refinery. These tests did not follow any set standards for testing but all materials were given equal treatments under similar conditions for comparison purposes.

PART I - Published Physical Properties

<u>Physical Property</u>	<u>Careytemp</u>	<u>Thermobestos</u>	<u>Kaylo</u>	<u>Unibestos</u>
Transverse Strength	70 lbs/sq in	95 lbs/sq in	50 lbs/sq in	120 lbs/sq in
Temperature Range	1600°	1200°	1200°	1200°
Compressive Strength	65 lbs/sq in 1% def.	165 lbs/sq in 5% def.	150 lbs/sq in 5% def.	1600 lbs/sq ft 5% def.
Linear Shrinkage	0.7% @ 1200° 1.2% @ 1500°	1.5% @ 1200°	1.4% @ 1200°	0.057% @ 1200° 0.01% @ 750°
Density	9 lbs/cu ft	11 lbs/cu ft	11 lbs/cu ft	18 lbs/cu ft
Moisture Resistance	0.2% in 24 hrs @ 90% RH	Not shown	0.9% in 6 hrs @ 90% RH	1.01% in 24 hrs @ 90% RH
Water Resistance	0.8% pickup immersed for 2 hrs	-	-	-
Thermal Conductivity:				
100°F	0.33	0.33	0.33	0.36*
200°F	0.37	0.37	0.37	0.42
300°F	0.42	0.41	0.41	0.47
400°F	0.46	0.46	0.46	0.52
500°F	0.51	0.50	0.50	0.57
600°F	0.56	0.55	0.55	0.62
700°F	0.61	0.60	0.61	0.67

* Pittsburgh Testing Laboratory of Chicago conducted a test on Unibestos in July, 1958. This test indicated the thermal conductivity to be 0.331 at 323°F and a 5-hour testing period.

PART II - Laboratory and Field Tests & Observations

A. Water Resistance

1. Submerged in water 4-1/2 hrs

	Water Absorbed	
	% by wt	% by vol
Careytemp	44	7.4
Thermobestos	527	75.4
Kaylo	434	72.8
Unibestos	355	73.6

B. Moisture Resistance

1. Oven dried then exposed to moisture for 70 hours. (Over 90% RH)

Careytemp	2.77	0.40
Thermobestos	14.50	2.56
Kaylo	4.28	0.76
Unibestos	8.94	2.58

C. Chemical Resistance

1. The reactions with Ammonium Hydroxide, 12% sulphuric acid, and 10% Oxalic-acid were about the same:

- a. Careytemp would not absorb any of these and there was no noticeable reactions.
- b. Thermobestos and Kaylo formed a soft mud-like substance on the surface.
- c. Unibestos absorbed the liquids but no reactions were evident.

2. When tested with Benzol and MEK, the reactions were the same as in "1" above except that Careytemp will readily absorb these less viscous liquids.

D. Fire Resistance

1. When exposed to open flame, none of these insulations would burn. The heat and/or flame did cause the following:

- a. Careytemp turns black, the fibers get weak, and the insulation becomes more brittle.
- b. Thermobestos -- small cracks form and the insulation becomes softer and easier to crumble.
- c. Kaylo turns blue-gray then gray; many small cracks form and the insulation becomes harder and easier to crumble.
- d. Unibestos -- the outside coating turns white and small cracks form; the rest of the insulation turns black and gets hard.

E. Heat Resistance

1. Heated to 1200°F

- a. All insulations are still usable with only slight changes in color and strength.

2. Heated to 1400°F

- a. Careytemp turns dark gray, the fibers lose their strength and become weaker. However, no shrinkage cavities appear and the insulation is still usable.
- b. Thermobestos turns pink, cracks throughout and becomes very weak.
- c. Kaylo turns light pink, becomes weak and brittle. Many cracks and cavities appear on the ends as it shrinks up badly.
- d. Unibestos turns brown, gets harder and a little brittle, holds form well with no cracks or shrinkage cavities, and is still a usable insulation.

F. Shock Resistance

1. Each insulation was hammer tested.
 - a. Careytemp cracked excessively, almost to the point of shattering.
 - b. Thermobestos absorbed the shock fairly well with little indentation but several small cracks appeared.
 - c. Kaylo reacted similar to thermobestos but cracked a little more.
 - d. Unibestos was dented in the outside coating only where the hammer made contact. No cracks formed. The shock was absorbed very well.

G. Abrasion Resistance

1. When exposed to a rubbing action, the following effects were noticed:
 - a. Careytemp is easily rubbed down into a powder. It would not stand excessive vibration.
 - b. Thermobestos and Kaylo resist abrasion quite well. Does not rub down too easily.
 - c. Unibestos resists abrasion best of all, would outlast the others.

H. Field Handling

1. This takes into consideration the handling of the materials from the time they arrive until they are installed.
 - a. Careytemp has a tendency to crack and chip off at the edges in transporting the material to its final location. No small size material was available for testing but the amount of waste material would probably be higher in the smaller sizes. Careytemp can be cut and shaped to exact dimensions but care must be exercised to keep from damaging the trimmed edges. The wire used to tie the insulation in place often cuts into the material.
 - b. Thermobestos holds up well with some breakage in the smaller sizes. It can be cut and shaped fairly easily. The tie wires have no ill effects.
 - c. Kaylo breaks quite easily in handling and often cracks while being cut. The tie wires will cut into Kaylo when drawn tight.
 - d. Unibestos can be handled the roughest with the least breakage. Its grain-like structure absorbs shock rather than cracking or crumbling. It can be cut and shaped fairly easily and the tie wires have no ill effects.
2. Careytemp, Thermobestos, and Kaylo arrive with cloth jackets which have to be removed before installation. Unibestos is tied with string which saves some time in preparing the material for installation.

Summary

1. Careytemp is lightest in weight and has a higher temperature range of 1600°F. It is highly resistant to water and most chemicals but cannot absorb shock or take rough handling.
2. Thermobestos has the greatest compressive strength and good workability.
3. Kaylo had no outstanding quality that surpassed all of the other insulations.
4. Unibestos has the greatest transverse strength and ability to absorb shock. It can be treated rough with little breakage and be reused often. It is resistant to most chemicals and the linear shrinkage is lower than that of the other insulations. This material weighs more than the others.

5. All of the materials have good thermal conductivity ratings and all are highly fire resistant.

Recommendations

1. Based on this study, the following recommendations are made:
 - a. That Unibestos and Thermobestos be used as our hot pipe insulations because they display the most desirable qualities and would undoubtedly prove to be more economical than the others because of less waste due to breakage.
 - b. That Careytemp and Kaylo be considered as suitable substitutes when situations warrant the use of products other than Unibestos or Thermobestos.

✓/ASBaranski:ECW
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