TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA/TX-87/47+435-2F		

4. Title and Subtitle	5. Report Date
LIME AND CEMENT TREATMENT OF SOILS FOR REPAIR OF EARTH SLOPES	November 1986
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Thomas W. Kennedy and Robert D. Smith	Research Report 435-2F
9. Performing Organization Name and Address	10. Work Unit No.
Center for Transportation Research The University of Texas at Austin Austin, Texas 78712-1075	11. Contract or Grant No. Research Study 3-8-85-435
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Texas State Department of Highways and Public Transportation; Transportation Planning Division P. O. Box 5051 Austin, Texas 78763	Final
	14. Sponsoring Agency Code

15. Supplementary Notes

Study conducted in cooperation with the U. S. Department of Transportation, Federal Highway Administration

Research Study Title: "Repair of Slides in Earth Slopes"

16. Abstract

This report summarizes a study to evaluate lime and cement treatment of soils for the repair of earth slopes. The study involved three Texas soils, two treatment levels using both portland cement and hydrated lime, two levels of compaction for one soil, and two levels of pulverization for soils treated with portland cement. Testing involved the determination of Atterberg limits and wet and dry unconfined compressive strengths after curing for various time periods.

Lime was shown to be best with highly plastic, dry soils and soils compacted to a high level of density. Cement tended to be superior at low densities and with low plasticity, sandy soils. Both soils tended to experience significant losses of strength when allowed to absorb water. The losses, however, were generally much less for lime treated materials.

In terms of slope stability analyses, both treatments produced strength values, even when wet, exceeding the strength values at which slope failures would be expected to occur. It is felt that the loss of strength and resulting slope failures probably are associated with cracking of the treated soil. Further, evaluations under conditions of wetting and drying should be conducted to further analyze the use of cement and lime for soil slopes which have failed.

17. Key Words	18. Distribution Statement
earth slopes, repair, soils, lime, cement, compaction, pulverization, Atterberg limits, compressive strength, wet, dry	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	108	

Form DOT F 1700.7 (8-69)

LIME AND CEMENT TREATMENT OF SOILS FOR REPAIR OF EARTH SLOPES

by

Thomas W. Kennedy
Robert D. Smith

Research Report Number 435-2F

Repair of Slides in Earth Slopes
Research Project 3-8-85-435

conducted for

Texas
State Department of Highways and Public Transportation

in cooperation with the
U.S. Department of Transportation
Federal Highway Administration

by the

Center for Transportation Research
Bureau of Engineering Research
The University of Texas at Austin

November 1986

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

There was no invention or discovery conceived or first actually reduced to practice in the course of or under this contract, including any art, method, process, machine, manufacture, design or composition of matter, or any new and useful improvement thereof, or any variety of plant which is or may be patentable under the patent laws of the United States of America or any foreign country.

PREFACE

This is the second and final report summarizing the findings of a research project concerned with the repair of earth slopes. This report is concerned with the use of hydrated lime and portland cement to treat soils in slopes which have failed.

The work required to develop this report was conducted by many people. Special appreciation is extended to Messrs. James N. Anagnos, Maghsoud Tahmoressi, and Eugene Betts. In addition, the authors would like to express their appreciation to Mr. Christopher Goss of the Texas Department of Highways and Public Transportation for his suggestions, encouragement, and assistance in this research project. Appreciation is also extended to the National Lime Association and the Texas lime producer who sponsored a portion of the study included in this report. Appreciation is also extended to the Center for Transportation Research and the Bureau of Engineering Research who assisted in the preparation of this report. The support of the Federal Highway Administration is acknowledged.

Thomas W. Kennedy
Robert D. Smith

November 1986

LIST OF REPORTS

Report No. 435-1, "Stability Computation Procedures for Earth Slopes Containing Internal Reinforcement," by Stephen G. Wright and Fernando Cuenca, contains the fundamental limit equilibrium slope stability equations for computing the stability of earth slopes containing synthetic reinforcement.

Report No. 435-2F, "Lime and Cement Treatment of Soils for Repair of Earth Slopes," by Thomas W. Kennedy and Robert D. Smith, summarizes a study of the wet and dry unconfined compressive strengths of three Texas soils treated with portland cement or hydrated lime.

ABSTRACT

This report summarizes a study to evaluate lime and cement treatment of soils for the repair of earth slopes. The study involved three Texas soils, two treatment levels using both portland cement and hydrated lime, two levels of compaction for one soil, and two levels of pulverization for soils treated with portland cement. Testing involved the determination of Atterberg limits and wet and dry unconfined compressive strengths after curing for various time periods.

Lime was shown to be best with highly plastic, dry soils and soils compacted to a high level of density. Cement tended to be superior at low densities and with low plasticity, sandy soils. Both soils tended to experience significant losses of strength when allowed to absorb water. The losses, however, were generally much less for lime treated materials.

In terms of slope stability analyses, both treatments produced strength values, even when wet, exceeding the strength values at which slope failures would be expected to occur. It is felt that the loss of strength and resulting slope failures probably are associated with cracking of the treated soil. Further, evaluations under conditions of wetting and drying should be conducted to further analyze the use of cement and lime for soil slopes which have failed.

SUMMARY

The use of hydrated lime to treat plastic clay soils has long been recognized as an effective method of improving the engineering characteristics and behavior of the soil. Lime has also been used to prevent or repair slope failures. Nevertheless, lime-treated soils in slopes have on occasion failed. The study summarized in this report was designed as the first in a series of studies to determine whether hydrated lime could be used for the repair of slope failures. Included was information related to the possible use of portland cement.

The study involved three Texas soils, two treatment levels using both portland cement and hydrated lime, two levels of compaction for one soil, and two levels of pulverization for soils treated with portland cement. Testing involved the determination of Atterberg limits and the wet and dry unconfined compressive strength after curing periods of up to 126 days.

Lime was shown to be best with highly plastic, dry soils and soils compacted to a high level of density. Cement tended to be superior at low densities and with low plasticity, sandy soils. Both soils tended to experience significant losses of strength when allowed to absorb water. The losses, however, were generally much less for lime treated materials.

In terms of slope stability analyses, both treatments produced strength values, even when wet, exceeding the strength values at which slope failures would be expected to occur. It is felt that the loss of strength and resulting slope failures probably are associated with cracking of the treated soil.

IMPLEMENTATION STATEMENT

The results summarized in this report are based on a laboratory study to evaluate hydrated lime and portland cement as a means to repair slope failures by treating the soil in the slopes. The results indicate that the treated soils have sufficient strength, under dry and wet conditions, to prevent failures. Nevertheless, treated soils in slopes have been known to fail. It is therefore felt that wetting and drying probably cause cracking and a much more significant loss in strength. This behavior needs to be further evaluated.

The study, however, did reaffirm the applicability of hydrated lime for treating plastic clays. The strength losses associated with moisture absorption were also less for well compacted plastic clays treated with hydrated lime.

TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION

The use of hydrated lime to treat plastic clay soils has long been recognized as an effective method of improving the engineering characteristics and behavior of these soils. In addition to traditional subgrade stabilization, hydrated lime has also been used to prevent or repair slope failures. Nevertheless, lime-treated earth slopes have on occasion failed.

Thus, a study was conducted to evaluate hydrated lime as a means of repairing slope failures. The study was conducted in conjunction with a study sponsored by the National Lime Association and Texas Lime Producers which evaluated both lime and cement treatment of Texas soils.

The study, summarized in this report, involved three Texas soils, two treatment levels using portland cement and hydrated lime, two levels of compaction on one soil, and the treatment of pulverized and unpulverized soil with portland cement. Testing involved the determination of Atterberg Limits and wet and dry unconfined compressive strengths after curing for various time periods.

Chapter 2 contains a description of the experimental program. Chapter 3 summarizes and discusses the findings. Conclusions and summary are contained in Chapter 4.

CHAPTER 2. EXPERIMENTAL PROGRAM

The objectives of the study were to compare the dry and wet unconfined compressive strength characteristics of soils treated with hydrated lime and portland cement, to evaluate the importance of pulverization on the unconfined compressive strength of soils treated with portland cement, and to determine the effect of compactive effort.

EXPERIMENTAL PROGRAM

The experimental program involved three soils, two stabilizing agents (hydrated lime and portland cement), two levels of treatment, two levels of pulverization, two levels of compaction, two levels of moisture conditioning, and a range of curing times.

MATERIALS

Soils

Three Texas soils were used in the study. Two of the soils were from Dallas County and are described as Dalco clay and Dalco sandy clay. The third soil was from Harris County near Houston and is described as Beaumont clay. The characteristics of the three soils are summarized in Table 1.

Table 1. Characteristics of Soils

Soil	Liquid Limit	Plastic Limit	Plasticity Index	Minus No. 200 Material	Unified Soil Class.
Dalco Clay	72	33	39	100	CH
Beaumont Clay	60	24	36	100	CH
Dalco Sandy Clay	27	16	11	49	SC

Additives

The three soils were treated with commercially available portland cement and hydrated lime. The cement was Type I portland cement manufactured by Alamo Cement Company of San Antonio, Texas. The lime was hydrated lime manufactured by Austin White Lime Company of Austin, Texas.

The three soils were treated with 4 or 7 percent portland cement or hydrated lime, based on the dry weight of the soil. These treatment levels would be expected to fully stabilize the lime-treated soils and modify the cement-treated soils. However, these application rates are currently being utilized in Texas and relative performances and costs compared.

LABORATORY PROCEDURE

The following laboratory procedures were utilized in an attempt to simulate field conditions as closely as possible.

Pulverization

The soils were oven-dried at 110°F for a period of 5 days, and were then pulverized and sieved over the 3/4-inch sieve and the number 4 sieve. The three soil sizes were combined to produce soils satisfying the following gradation requirements:

Pulverized - 100 percent passing the number 4 sieve

Unpulverized - 85 percent passing the number 4 sieve and 15 percent passing the 1-1/2-inch sieve and retained on the 3/4-inch sieve.

Treatment

Four or seven percent portland cement or hydrated lime was added to the dry soil according to the procedures summarized below.

Portland Cement. Cement was added along with sufficient water to produce the optimum moisture content for the cement-soil mixture. The soil and cement were mixed for approximately 5 minutes using a one cubic foot Lancaster automatic mixer (Fig 1). The soils were compacted immediately following mixing without curing, which simulates practice currently used on Texas projects.

Hydrated Lime. Lime was added to the soil in the form of a lime-water slurry. The amount of water was equal to that required to produce the optimum water content for the mixture. The soil and lime were mixed for approximately 5 minutes using the Lancaster mixer. The lime-treated mixtures were placed in plastic bags (Fig 2) and allowed to mellow, or cure, for three days prior to compaction. This curing procedure, which may not be required if adequate pulverization can be obtained, is similar to the procedure often used in lime stabilization construction.

No Treatment. The soil was mixed at the optimum water content for approximately 5 minutes and compacted immediately after mixing (Fig 3).

Compaction

Treated and untreated soils were compacted at the optimum moisture for maximum dry density (Table 2) using the following compactive efforts and procedures:

Dalco sandy clay	- Modified AASHTO (ASTM D-1557)
Dalco clay	- Modified AASHTO (ASTM D-1557)
Beaumont clay	- Modified AASHTO (ASTM D-1557)
	- Standard AASHTO (ASTM D-698)

As previously mentioned, the untreated and cement-treated soils were compacted immediately after mixing without a curing period, while the lime-treated soils were compacted after the three-day mellowing period. Additional water was added prior to compaction to bring the mixture to the optimum water content to achieve maximum dry density for the specified compactive effort.

Table 2. Optimum Moisture Contents for Compaction

Soil	Compactive Effort	Untreated %	Cement Treated 4%	Cement Treated 7%	Lime Treated 4%	Lime Treated 7%
Dalco Sandy Clay	Modified AASHTO	9.7	10.4	10.2	12.4	12.6
Dalco Clay	Modified AASHTO	23.5	21.5	17.5	26.0	26.0
Beaumont Clay	Modified AASHTO	16.7	--	15.5	--	18.5
Beaumont Clay	Standard AASHTO	21.5	26.0	24.0	20.2	20.5

Curing

One set of specimens was tested immediately after compaction and served as a control. All of the other specimens were wrapped in plastic (Fig 4) to prevent loss of moisture and were placed in a room at 72°F and 65 percent relative humidity for periods of 0, 7, 28, or 119 days. After the initial curing period, the specimens to be subjected to wetting were unwrapped, removed, and placed on porous stones in a pan of water in a 100 percent humidity room for 7 days (Fig 5). The specimens to be tested in the dry condition were allowed to cure for an additional 7 days. Thus the total cure times were 0, 7, 14, 35, and 126 days, including the specimens tested immediately after compaction, as shown in Table 3.

Table 3. Curing Times

Cure Period	Days of Curing				
Initial cure	0	0	7	28	119
Additional cure	0	7	7	7	7
Total cure	0	7	14	35	126

Testing

Immediately following the prescribed total curing period, the specimens were tested in unconfined compression according to ASTM D1663-63. Specimens were loaded at a constant deformation rate of 0.115 inches per minute at 75°F and the load and corresponding vertical deformations were recorded on an X-Y plotter.

PROPERTIES ANALYZED

Plasticity characteristics (Atterberg Limits) and unconfined compressive strengths were determined for the treated and untreated soils.

Atterberg Limits

The liquid limit, plastic limit, and plasticity index were determined immediately after treatment for portland cement and after a 3-day mellowing (cure) period for hydrated lime.

Unconfined Compressive Strength

The unconfined compressive strength was determined over the range of curing times. Tests were conducted on both dry and wet cured specimens as described under curing.

EXPERIMENT DESIGN

The experiment design is summarized in Figure 6. Two replicate specimens per cell or test condition were tested as indicated by the numbers. The longer term curing conditions were prepared first in order to minimize the time required for the study. All treatment levels were coded to minimize bias during testing.

CHAPTER 3. PRESENTATION OF RESULTS

The primary objective of this study was to compare the strength and plasticity characteristics of three cement-treated and lime-treated Texas soils. Unconfined compression tests on compacted specimens were used to evaluate the strengths of the treated soils. The strengths of dry and wet specimens were compared to establish the moisture susceptibility, or retained strength, of the treated soils. The importance of pulverization on the strength of cement-treated soils and the effects of the degree of compactive effort on both cement-treated and lime-treated soils were evaluated.

ATTERBERG LIMITS

As shown in Table 4 and Figures 7 through 12, both cement and lime produced no change or a slight increase in the liquid limits and a large increase in the plastic limits, thus producing a significant decrease in the plasticity indices of the treated soils.

The higher plasticity Dalco clay exhibited an approximate 50 percent decrease in the plasticity index, whereas Beaumont and Dalco sandy clays exhibited lower reductions of the plasticity index. The lime was slightly more effective in reducing the plasticity index; however, except for the Dalco sandy clay, the differences were of no practical significance.

MOISTURE CONTENT AFTER CURING

After testing each specimen, a moisture sample was obtained and the moisture content for each specimen was determined at the time of testing. Figures 13 through 22 show the changes in moisture content with time for both dry and wet cured specimens.

All specimens were subjected to dry curing. The specimens labeled wet cured, however, were subjected to 7 days of wetting prior to testing. Thus, there were no wet cured specimens at zero days of total cure time. The dry cured specimens were wrapped and allowed to cure until tested. Thus, the

Table 4. Atterberg Limits of Untreated and Treated Soils

Soil	Treatment Level	Liquid Limit	Plastic Limit	Plasticity Index
Dalco Clay	Untreated	72	33	39
	4% Cement	72	51	21
	7% Cement	69	49	20
	4% Lime	72	52	20
	7% Lime	73	57	16
Beaumont Clay	Untreated	60	24	36
	4% Cement	60	38	22
	7% Cement	64	41	23
	4% Lime	70	49	21
	7% Lime	71	49	22
Dalco Sandy Clay	Untreated	27	16	11
	4% Cement	29	19	10
	7% Cement	27	20	7
	4% Lime	28	24	4
	7% Lime	30	23	7

reductions in moisture content of the dry cured specimens during the curing period represent the moisture loss of the specimens.

Dalco Clay

As illustrated in Figures 13 through 15, the pulverized Dalco clay treated with both cement and hydrated lime and compacted to modified AASHTO tended to lose about 3 percent moisture during the total curing period. The unpulverized cement-treated mixtures tended to lose slightly more moisture.

During the 7-day wet cure period the 7 percent lime mixtures indicated very little moisture increase while the 4 percent lime mixtures exhibited about 3 percent moisture increase. In contrast, the cement-treated specimens exhibited much higher moisture gains, especially after relatively short dry curing periods.

Beaumont Clay

The moisture content relationships for Beaumont clay are illustrated in Figures 17 through 19. The change in moisture content during the curing period was highly dependent on degrees of compaction and pulverization. For pulverized, modified AASHTO compacted specimens, the cement treated mixtures experienced slightly higher moisture losses during the dry curing periods and higher moisture gain during wet curing periods. This difference between cement- and lime-treated material was more evident at early stages of curing. Lime-treated standard AASHTO compacted Beaumont clay exhibited lower moisture loss during dry curing than cement-treated Beaumont clay. However, lime-treated specimens gained more moisture than cement-treated specimens when cured wet. Cement treated unpulverized Beaumont clay showed approximately 5 percent moisture loss for dry cured specimens; however, moisture gain of wet cured specimens was negligible, except at early stages of curing where moisture gain was high.

Dalco Sandy Clay

The moisture content relationships for Dalco sandy clay are illustrated in Figures 20 through 22. Both the lime- and cement-treated materials exhibited the same amount of moisture loss during dry curing. During wet curing, all specimens experienced negligible moisture gain except specimens treated with 4 percent lime which were pulverized and modified AASHTO compacted. These specimens gained approximately 2 percent moisture. For Dalco sandy clay, the degree of pulverization generally did not affect moisture loss during dry curing; however, pulverized specimens indicated lower moisture loss when cured wet. Moisture loss during the wet curing period means that at the end of 7 days of wet curing, moisture content of the specimen was less than the moisture content at the time of compaction. This situation can be possible when the specimen loses more water during the dry curing period than it can gain during 7 days of wet curing.

In general, the high plasticity Dalco clay and modified compacted Beaumont clay indicated higher moisture loss when cured wet. It may be possible that with plastic clays, cement treatment may cause cracking in the soil which will in turn lead to increased moisture gain. For conditions of this study, this tendency to absorb moisture and cracking is more evident at early stages of curing.

UNCONFINED COMPRESSIVE STRENGTH

The relationships between unconfined compressive strength and total cure time are illustrated in Figures 23 through 50. Average strength values are summarized in Table 5 and individual strength values are contained in Appendix A.

Both cement and lime treatment increased the strengths of the three soils, and the magnitude of the strength increase was greater for increased amounts of lime and cement. The unconfined compressive strength generally tended to increase with increased curing time. In a few cases, there was a significant loss in strength between 35 and 126 days of curing, which cannot be explained except possibly by experimental error.

Pulverized Soil

The effects of cement and lime treatment of soils, which were pulverized to 100 percent passing the number 4 sieve, were dependent on soil type, or soil plasticity, and the compactive effort utilized to produce the specimens.

Dalco Clay. The relationships between strength and total curing time are shown in Figures 23 through 26, and average values are summarized in Table 5. Lime-treated Dalco clay specimens exhibited significantly higher strengths than the cement-treated specimens when tested in either the dry or wet condition.

The dry unconfined compressive strengths (Fig 23) of the 4 and 7 percent lime-treated Dalco clay were relatively high with 126-day strengths of 443 and 746 psi, respectively. The 4 and 7 percent cement-treated clays exhibited 126-day strengths of 236 and 347 psi, respectively.

The wet cement-treated soil (Fig 24) had very low strengths at 7 and 14 days of total curing and in some cases the specimens could not be tested (Fig 27). The strengths increased with further curing but were less than 75 psi after 126 days. In comparison, the 4 and 7 percent lime-treated soils had wet strengths of 286 and 612 psi after 126 days.

Thus, for the dry condition, the lime-treated specimens were approximately two times stronger than the cement-treated specimens. For the wet specimens (Fig 24), however, the differences were much greater and in some cases the lime-treated clays were 10 times stronger than the cement-treated material. In fact, the wet conditioned compressive strengths of lime-treated soils were greater than the dry conditioned strengths of the cement-treated soils at both 4 and 7 percent treatment levels (Figs 25 and 26). These trends occurred throughout the 126-day curing period.

Beaumont Clay. The relationships between strength and curing time are shown in Figures 28 through 32, and average values are summarized in Table 5.

As shown in Figure 28, the modified compacted Beaumont clay in the dry condition had essentially equal strengths when treated with 7 percent cement or lime. After 126 days of curing, however, the lime-treated soils were slightly stronger than the cement-treated soil. When tested in the wet condition (Fig 28), however, the strength of the lime-treated soils greatly exceeded the strength of the cement-treated soil, indicating a significant loss of strength for the cement-treated specimens. As with the Dalco clay, a number of wet cement-treated specimens could not be tested, as shown in Figure 27.

In contrast, for the standard AASHTO compacted Beaumont clay specimens tested in the dry condition, the cement-treated specimens exhibited greater strengths than lime-treated specimens (Fig 29). When tested in the wet condition (Fig 30), the cement-treated specimens still had higher strengths but the difference between the dry and wet strengths of the cement-treated soils was greater than for the lime-treated soils (Figs 31 and 32), indicating that the cement-treated mixtures suffered a significantly greater loss in strength as a result of wet curing.

Dalco Sandy Clay. The relationships between strength and curing time are illustrated in Figures 33 through 36, and average values are summarized in Table 5. Cement treatment of the Dalco sandy clay produced significantly greater strengths than lime treatment in both the dry and wet condition (Figs 33 and 34). After 126 days of curing, the dry strengths were 1532 and 1090 for the cement-treated specimens with 7 and 4 percent cement, and 478 and 372 for the lime-treated specimens. In the wet condition, the strengths for the

Table 5. Average Unconfined Compressive Strengths

Soil	Compactive Effort	Moisture Condition	Total Cure Time, Days	Untreated Pulv. 0%	Cement-Treated * Pulv. 4%	Cement-Treated * Pulv. 7%	Cement-Treated * Unpulv. 4%	Cement-Treated * Unpulv. 7%	Lime-Treated * Pulv. 4%	Lime-Treated * Pulv. 7%
Dalco Clay	Modified AASHTO	Dry	0	53	129	173	-	-	170	139
			7	56	120	192	84	172	298	276
			14	35	107	254	83	94	294	303
			35	34	162	217	96	100	374	436
			126	48	236	347	164	167	443	746
		Wet	0	-	-	-	-	-	-	-
			7	3	6	11	3	8	234	221
			14	3	4	19	0	2	265	281
			35	4	59	44	36	23	346	394
			126	4	66	75	42	21	286	612
Beaumont Clay	Modified AASHTO	Dry	0	144	-	246	-	-	-	109
			7	208	-	404	-	-	-	398
			14	251	-	555	-	-	-	478
			35	319	-	850	-	-	-	681
			126	724	-	866	-	-	-	995
		Wet	7	0	-	24	-	-	-	48
			14	0	-	34	-	-	-	276
			35	0	-	96	-	-	-	354
			126	0	-	89	-	-	-	368
Beaumont Clay	Standard AASHTO	Dry	0	47	41	49	41	46	53	58
			7	51	101	139	72	151	70	78
			14	42	117	210	91	172	77	98
			35	48	130	253	117	229	104	201
			126	68	213	346	203	294	122	238
		Wet	7	1	15	25	4	13	7	12
			14	0	50	104	20	20	36	59
			35	0	67	152	25	46	58	133
			126	0	76	110	21	71	58	133
Dalco Sandy Clay	Modified AASHTO	Dry	0	65	166	150	153	155	94	97
			7	205	621	836	525	513	184	192
			14	189	836	1074	668	721	210	228
			35	243	1040	1435	934	907	368	344
			126	731	1090	1532	816	1305	372	487
		Wet	7	6	384	397	31	271	113	98
			14	16	632	883	251	410	140	134
			35	23	643	887	419	470	213	196
			126	12	406	718	175	565	216	263

* Additive expressed as percent by dry weight of soil.

cement-treated specimens were 718 and 406 psi and strengths for the lime-treated specimens were 263 and 216 psi. Thus, a greater loss was exhibited for the cement-treated soils than for the lime-treated soils (Figs 35 and 36). Nevertheless, the cement-treated soils with both 4 and 7 percent cement were stronger than the lime-treated soils. This is basically opposite to the trends exhibited by the Dalco clay and is attributed to the coarser grain size and lower plasticity.

Effect of Pulverization of Cement-Treated Soils

It has been suggested that a high degree of soil pulverization is not necessary prior to adding portland cement. This in effect would leave small clods of soil coated with cement and would not allow the cement to be intimately mixed with the soil particles. Thus, for the cement-treated portion of the study, the soil was also mixed with unpulverized soil as described under Laboratory Procedure - Pulverization, p. 4.

The relationships between unconfined compressive strength and total cure time for unpulverized and pulverized cement-treated specimens are contained in Figures 37 through 48.

Dalco Clay. In the dry condition, modified compacted specimens containing unpulverized soil were significantly weaker than specimens containing pulverized soil (Fig 37). After 126 days of curing, the specimens with 7 percent cement and unpulverized soil were only 50 percent as strong as the specimens containing pulverized soil. Similarly, with 4 percent cement the unpulverized specimens were about 67 percent as strong. In the wet condition, the losses were even greater, as shown in Figure 38. A comparison of the strength of unpulverized and pulverized specimens, tested wet and dry, illustrates the importance of pulverization (Figs 39 and 40).

Beaumont Clay. For the Beaumont clay, the effects of degree of pulverization were only evaluated for specimens compacted by standard AASHTO procedures. As shown in Figures 41 through 44, the effects of pulverization were similar to those exhibited by the Dalco clay specimens. The losses in the dry condition, however, were not as great and the losses in the wet condition were much larger than for Dalco clay.

Dalco Sandy Clay. The relationships shown in Figures 45 through 48 indicate that pulverization is also important but that the losses, related to the use of unpulverized soil, are much smaller. Thus, in more granular soil it may not be as important to pulverize the soil; however, at the same time it is easier to obtain a high degree of pulverization.

Summary. The effects of inclusion of unpulverized clods were more pronounced in the wet conditioned specimens. This was expected because during wet curing there was more available water to cause swelling of the clods. Swelling of the clods caused disruption of the specimens thus lowering the unconfined compressive strength.

The effects of the inclusion of unpulverized clods were more pronounced in the high plasticity clays. The cement-treated Beaumont clay and Dalco clay had greater reductions in strength for the unpulverized specimens, especially in the wet-conditioned specimens. Still, the very sandy clay, Dalco sandy clay, showed significant strength losses when comparing unpulverized to pulverized specimens.

Effects of Compactive Effort

The unconfined compressive strengths of standard and modified compacted 7 percent treated Beaumont clay specimens were compared to examine the effects of the degree of compactive effort. Unconfined compressive strength-total cure time relationships are shown in Figures 49 and 50.

In the dry condition, the increase from standard to modified compactive effort produced a two- to three-fold increase in strength for the lime- and cement-treated specimens. In the wet condition, the increase in compactive effort produced a similar two to three times increase in strength for the lime-treated specimens. The modified compacted cement-treated specimens' strengths were actually about 35 percent lower than the standard compacted cement-treated specimens' strengths.

The high plasticity Beaumont clay has a tendency to swell when contacted by water unless a stabilization treatment reduces this tendency to swell. An increase in compactive effort produces an increase in swell pressure along with the increase in density of a clay. The modified compacted cement-treated specimens seemed to have the swell pressure from water content increase superimposed on the increased swell pressure from the higher compactive effort. This increased swell pressure caused disruption of the modified compacted cement-treated specimens, leading to low strengths. The lime-treated modified compacted specimens did not show a decrease in strength from the standard compacted specimens when both were tested in the wet condition. It has to be assumed that the lime treatment reduced the tendency of this soil to swell when contacted by water.

CHAPTER 4. CONCLUSIONS

The following conclusions are based on the findings of this study and the conditions evaluated.

ATTERBERG LIMITS

1. Neither lime nor cement treatment produced any significant change in liquid limits.
2. Both lime and cement treatment produced a large increase in plastic limit, thereby decreasing the plasticity indices.
3. The reduction of the plastic index was greater for the Dalco clay than for the Beaumont clay or Dalco sandy clay.

MOISTURE CONTENT AFTER CURING

1. For the highly plastic Dalco clay and Beaumont clay which were modified AASHTO compacted, cement treatment led to higher moisture gain during wet curing than lime.
2. There is a possibility that cement treatment causes plastic clays to develop shrinkage cracks during dry curing, therefore causing higher moisture gain tendencies during wet curing periods.
3. For the less plastic Dalco sandy clay, no apparent difference was detected between cement- and lime-treated specimens.
4. Generally, cement-treated soils exhibited high moisture gains when subjected to wetting after short periods of curing.

UNCONFINED COMPRESSIVE STRENGTH

1. Lime treatment produced higher strengths than cement treatment for the modified compacted high plasticity Dalco and Beaumont clays. Significantly higher strengths were obtained from wet condition tests.

2. Cement treatment produced significantly higher strengths than lime treatment for the modified compacted low plasticity Dalco sandy clay. Higher strengths were obtained in both dry and wet condition tests.

3. Cement treatment of standard compacted Beaumont clay produced slightly higher strengths than lime treatment for both dry and wet conditions.

4. Wet-conditioned, modified compacted, cement-treated Dalco or Beaumont clay had low strengths. Extremely low strengths were recorded at total cure times of 7 and 14 days.

MOISTURE SUSCEPTIBILITY

1. Lime treatment of the modified compacted high plasticity clays provided a greater retention of their dry-conditioned strength when they were exposed to moisture. Lime treatment provided 2 to 4 times greater retention of strength as compared to cement treatment.

2. Lime-treated standard compacted Beaumont clay had slightly higher strength retention from the dry to wet condition. Although cement treatment gives higher strengths for both dry and wet conditions than lime, the amount of strength loss (difference between dry and wet strengths) is less for lime.

EFFECTS OF DEGREE OF PULVERIZATION

1. A small amount (15 percent) of unpulverized (3/4 inch to 1 1/2 inches) soil in a cement-treated soil mixture was found to cause a considerable decrease in strength compared to a cement-treated completely pulverized (100 percent minus 1/4 inch) soil mixture. This trend was evident for all three soils tested.

2. Lower strengths were obtained for the wet- and dry-conditioned unpulverized cement-treated soil specimens but a larger decrease in strength was observed in the wet-conditioned specimens.

3. Swelling of the dry unpulverized soil clods during curing was thought to be the major cause of distress in the specimens, thus leading to lower strengths.

EFFECTS OF COMPACTIVE EFFORT

1. Dry-conditioned compressive strengths increased greatly for the lime- or cement-treated Beaumont clay when the compactive effort was increased from the standard to modified compactive effort.

2. Wet-conditioned strengths decreased greatly for the cement-treated Beaumont clay when the compactive effort was increased from the standard to modified. Lime-treated Beaumont clay's wet-conditioned compressive strengths increased about the same percentage as the dry-conditioned strengths with increased compactive effort.

3. Increased swelling pressure induced by the increased compactive effort was thought to be the cause of the loss of strength in the wet-conditioned cement-treated clay specimen.

4. Lime treatment seemed to reduce the swelling tendencies of the expansive Beaumont clay while the cement treatment did not.

SUMMARY

Based on the results and conditions of this test program, lime treatment of the expansive high plasticity soils produced higher compressive strengths than cement treatment of these soils. Generally, lime treatment produced higher dry-conditioned strengths but the major advantage occurred for the wet-conditioned strengths. Lime treatment provided significantly better resistance to moisture damage when the soils were compacted by the modified AASHTO compactive effort.

Cement treatment of the low plasticity sandy clay produced significantly higher compressive strengths than lime treatment of this soil.

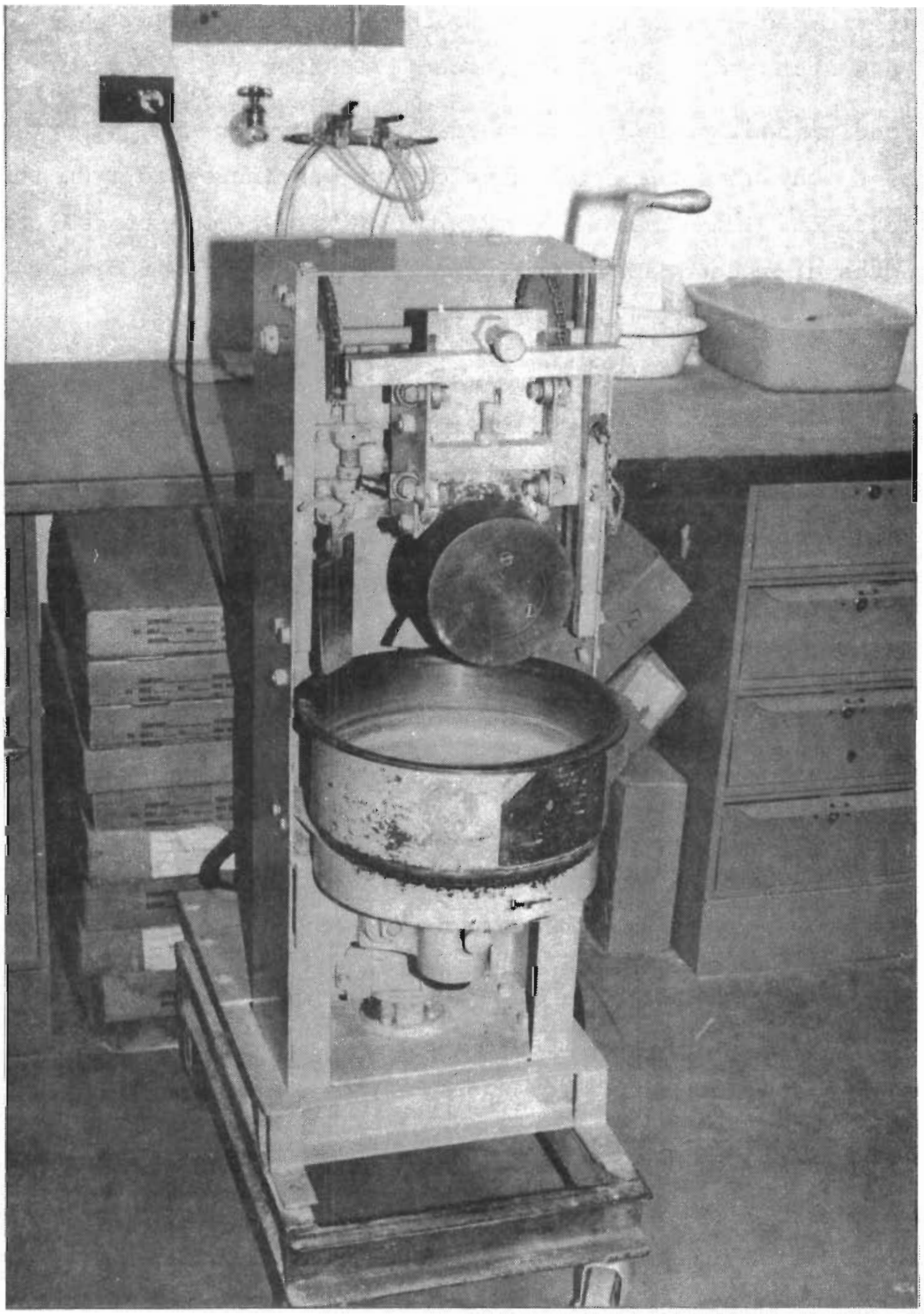


Fig 1. Lancaster Mixer used for mixing soil and additive.

Fig 2. Curing of lime-treated soil prior to compaction.

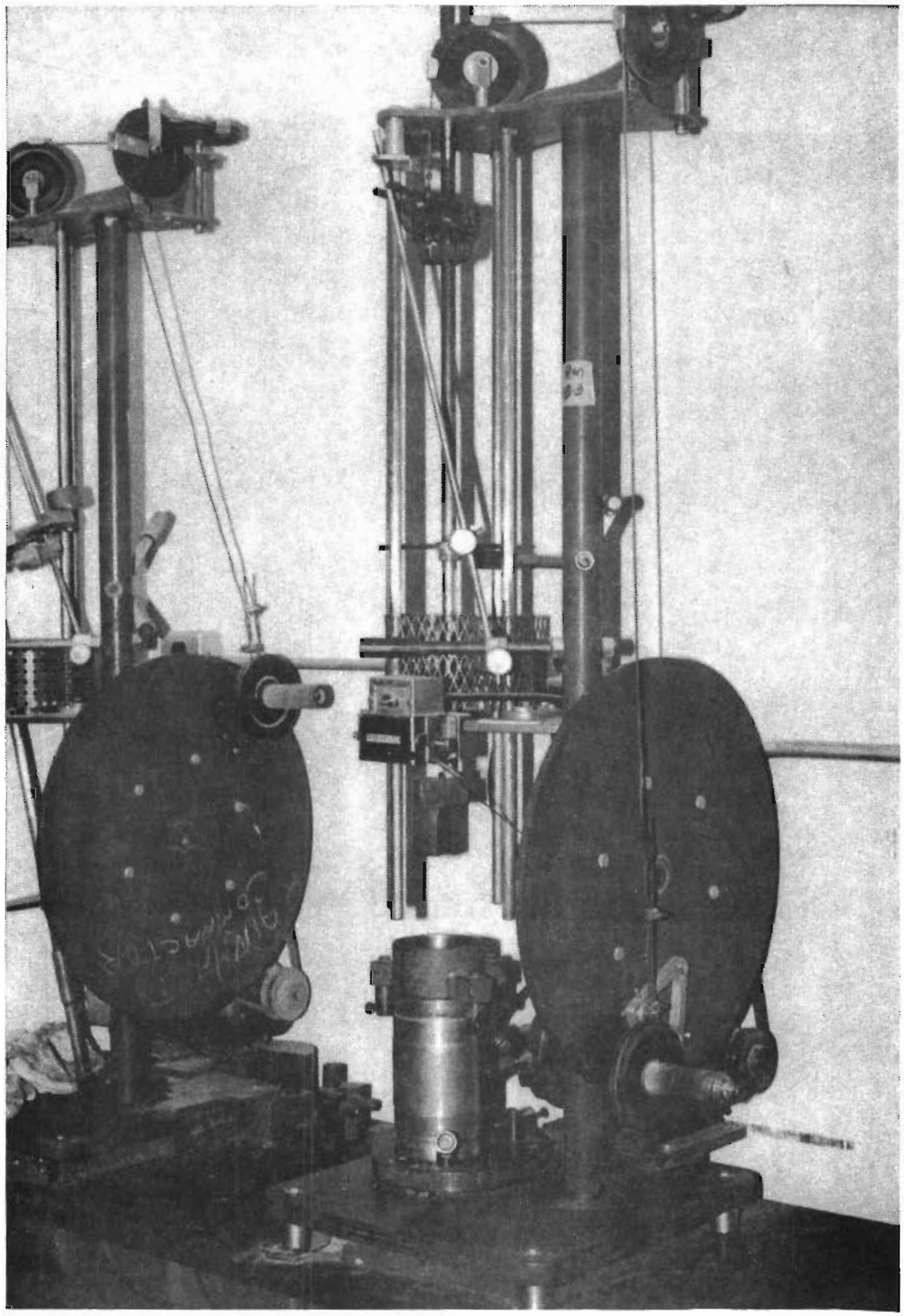


Fig 3. Compaction of treated and untreated soils.

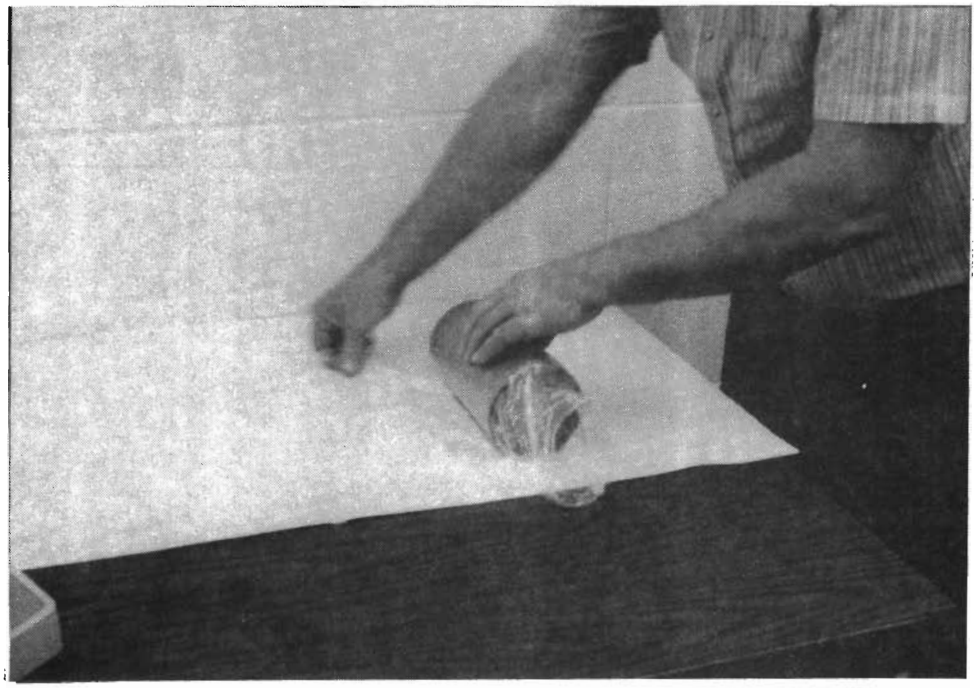


Fig 4. Specimen wrapped prior to curing.

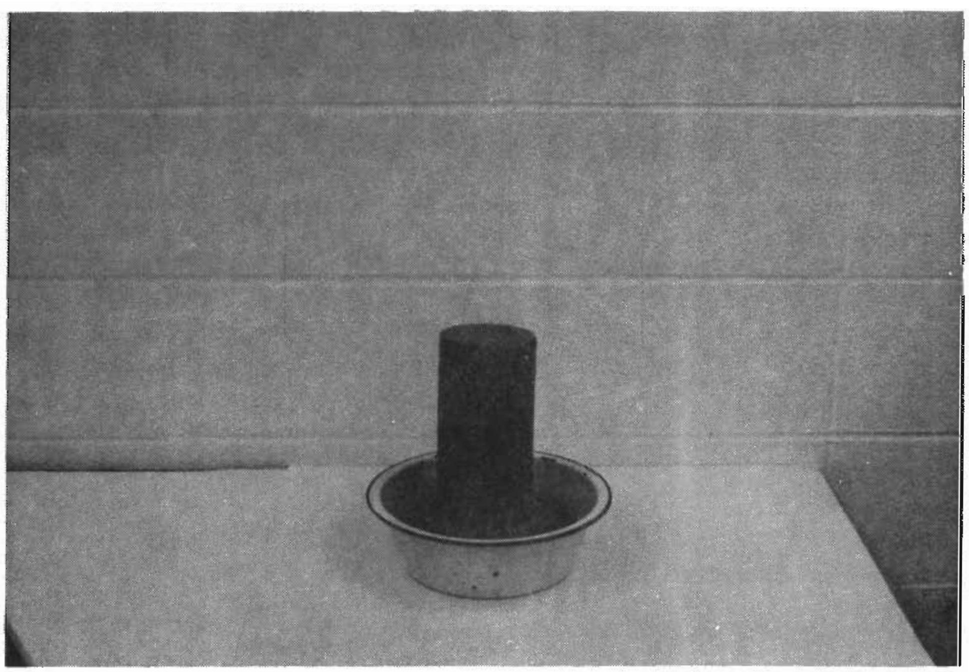


Fig 5. Wetting of specimens after initial curing.

Soil	Compactive Effort	Moisture Condition	Total Cure Time, Days	Untreated	Cement-Treated				Lime-Treated	
				Pulv.	Pulv.		Unpulv.		Pulv.	
				0%	4%	7%	4%	7%	4%	7%
Dalco Clay	Modified AASHTO	Dry	0	2	2	2	-	-	2	2
			7	2	2	2	2	2	2	2
			14	2	2	2	2	2	2	2
			35	2	2	2	2	2	2	2
			126	2	2	2	2	2	2	2
		Wet	7	2	2	2	2	2	2	2
			14	2	2	2	2	2	2	2
			35	2	2	2	2	2	2	2
			126	2	2	2	2	2	2	2
Beaumont Clay	Modified AASHTO	Dry	0	2	-	2	-	-	-	2
			7	2	-	2	-	-	-	2
			14	2	-	2	-	-	-	2
			35	2	-	2	-	-	-	2
			126	2	-	2	-	-	-	2
		Wet	7	2	-	2	-	-	-	2
			14	2	-	2	-	-	-	2
			35	2	-	2	-	-	-	2
			126	2	-	2	-	-	-	2
Beaumont Clay	Standard AASHTO	Dry	0	2	2	2	2	2	2	2
			7	2	2	2	2	2	2	2
			14	2	2	2	2	2	2	2
			35	2	2	2	2	2	2	2
			126	2	2	2	2	2	2	2
		Wet	7	2	2	2	2	2	2	2
			14	2	2	2	2	2	2	2
			35	2	2	2	2	2	2	2
			126	2	2	2	2	2	2	2
Dalco Sandy Clay	Modified AASHTO	Dry	0	2	2	2	2	2	2	2
			7	2	2	2	2	2	2	2
			14	2	2	2	2	2	2	2
			35	2	2	2	2	2	2	2
			126	2	2	2	2	2	2	2
		Wet	7	2	2	2	2	2	2	2
			14	2	2	2	2	2	2	2
			35	2	2	2	2	2	2	2
			126	2	2	2	2	2	2	2

428 Specimens Total

* Additive expressed as percent by dry weight of soil.

Fig 6. Experimental design for unconfined compression tests.

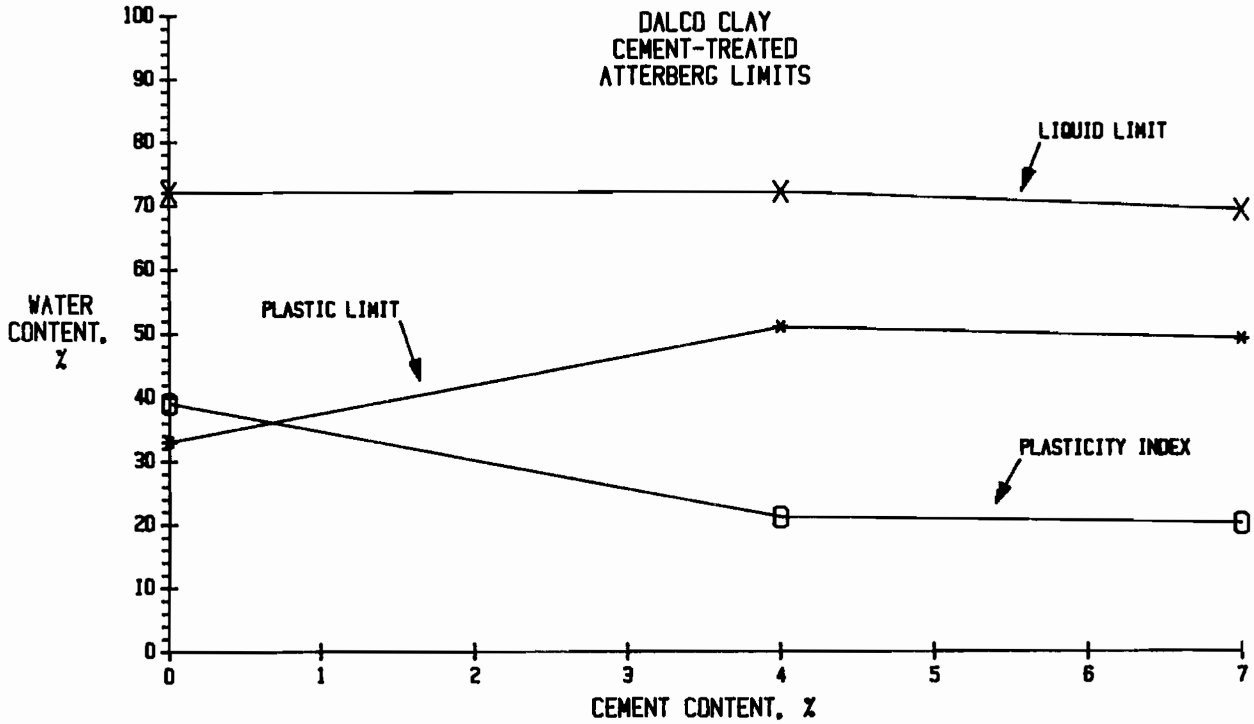


Fig 7. Atterberg limits of cement-treated Dalco clay.

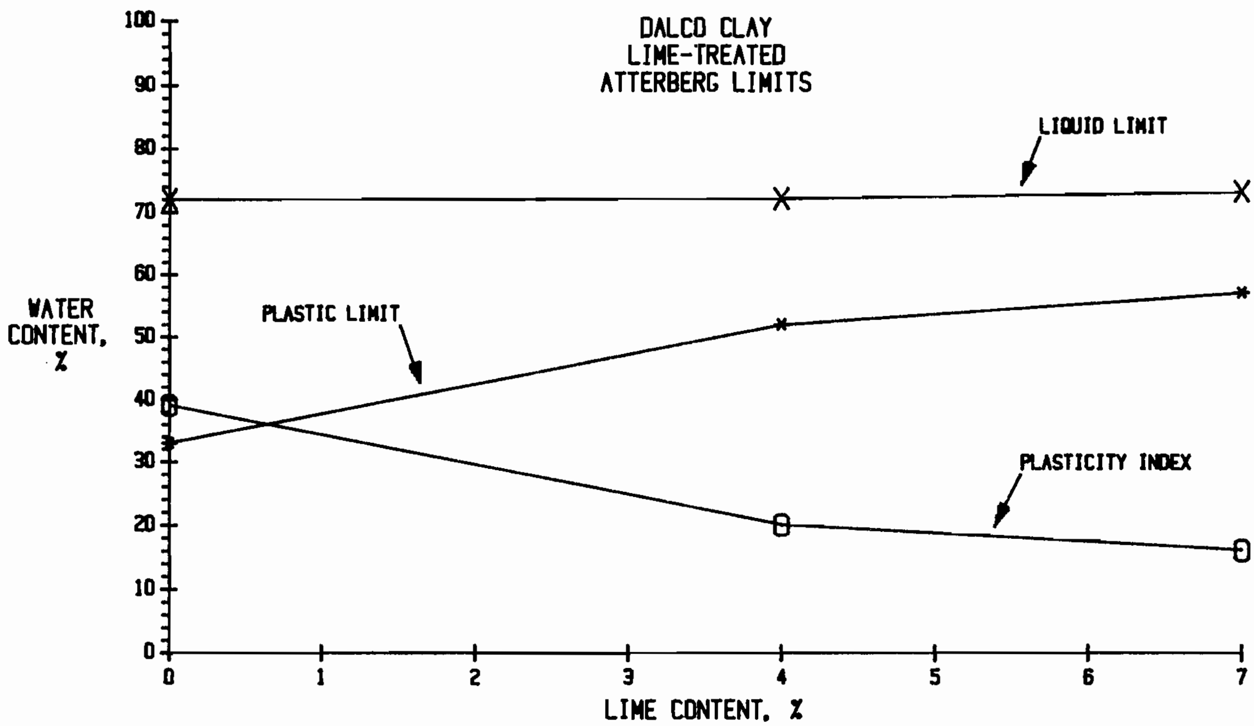


Fig 8. Atterberg limits of lime-treated Dalco clay.

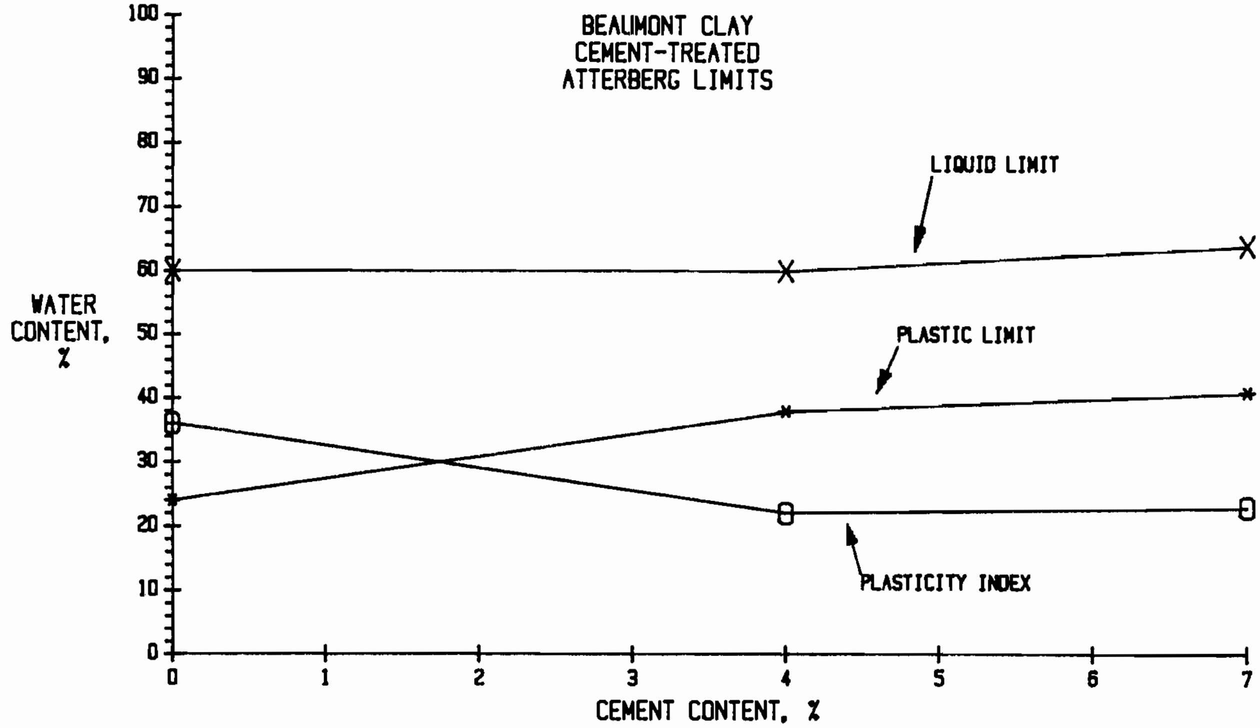


Fig 9. Atterberg limits of cement-treated Beaumont clay.

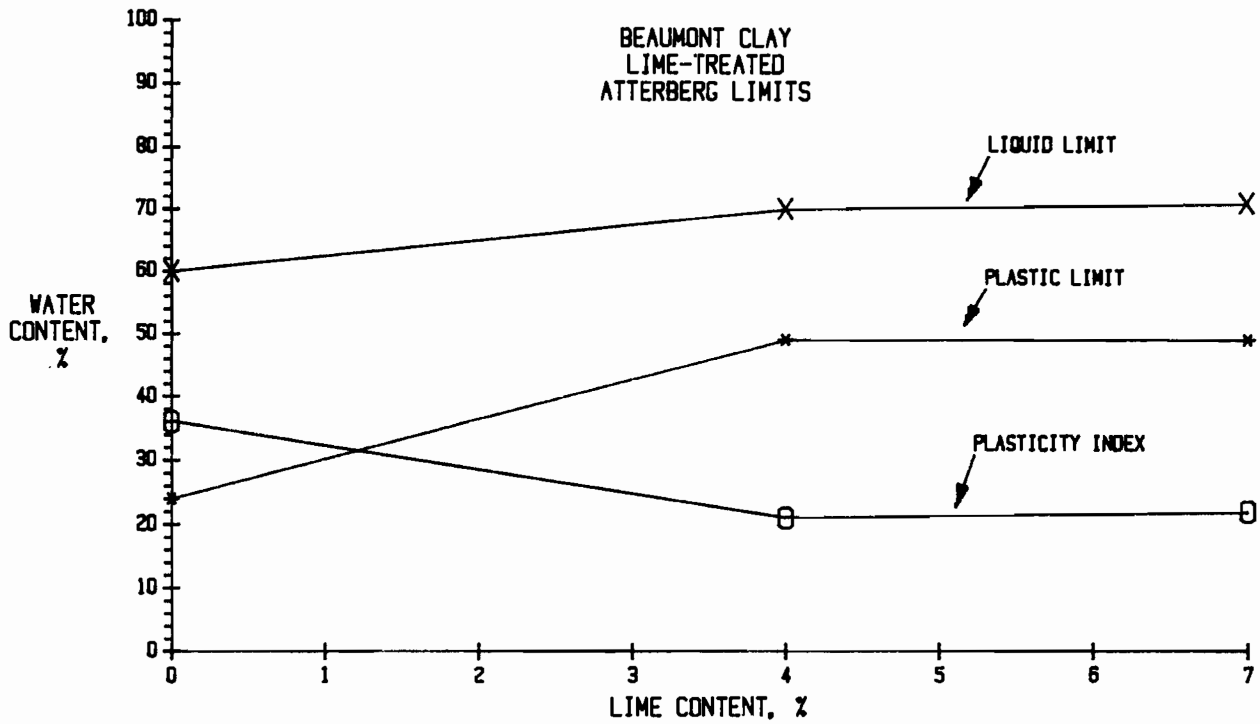


Fig 10. Atterberg limits of lime-treated Beaumont clay.

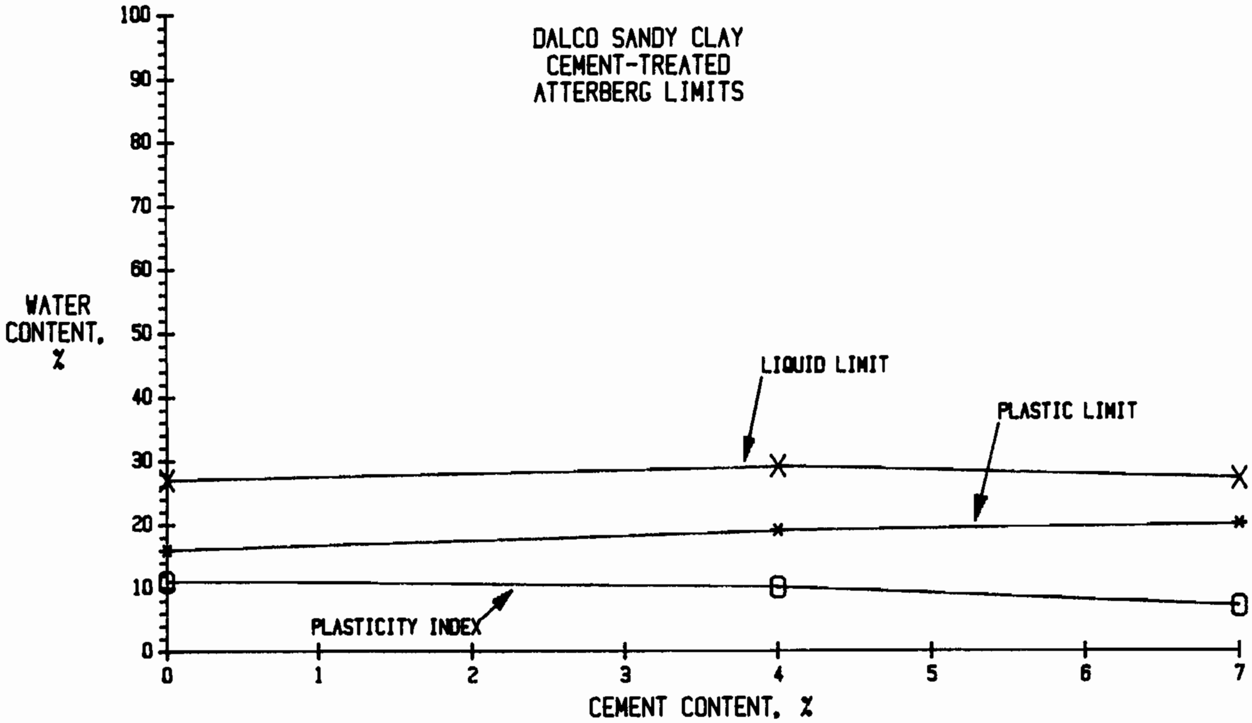


Fig 11. Atterberg limits of cement-treated Dalco sandy clay.

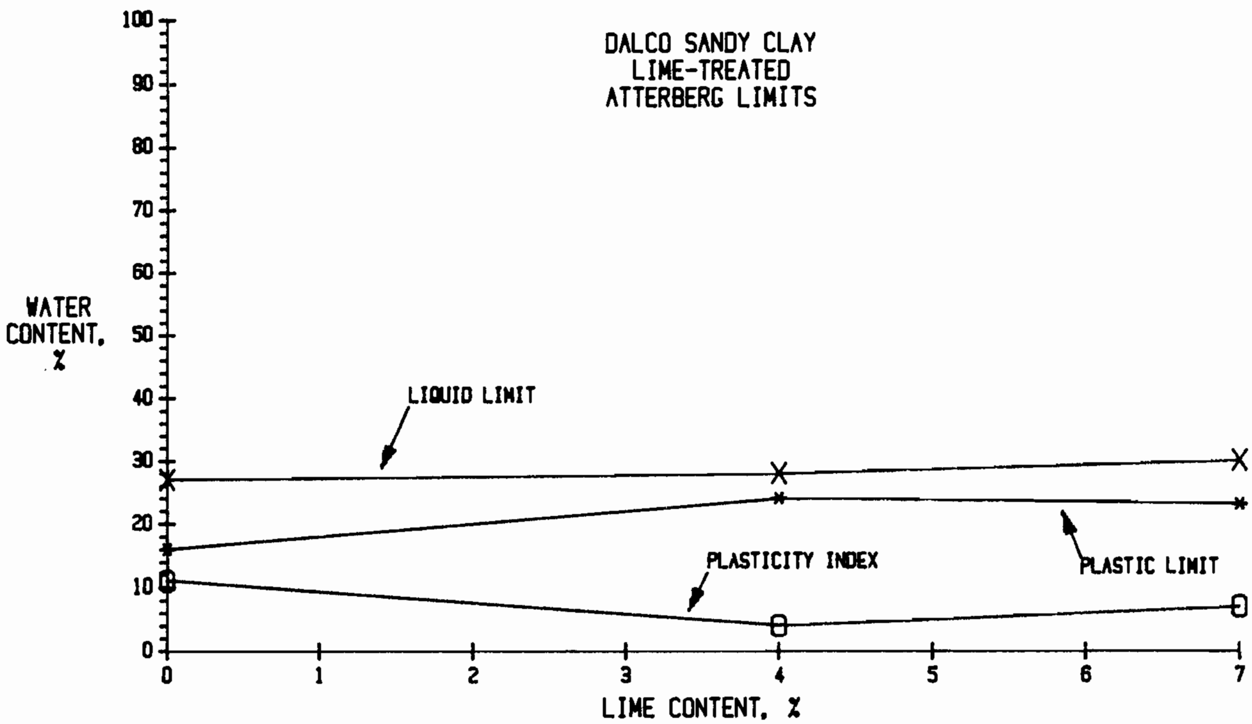


Fig 12. Atterberg limits of lime-treated Dalco sandy clay.

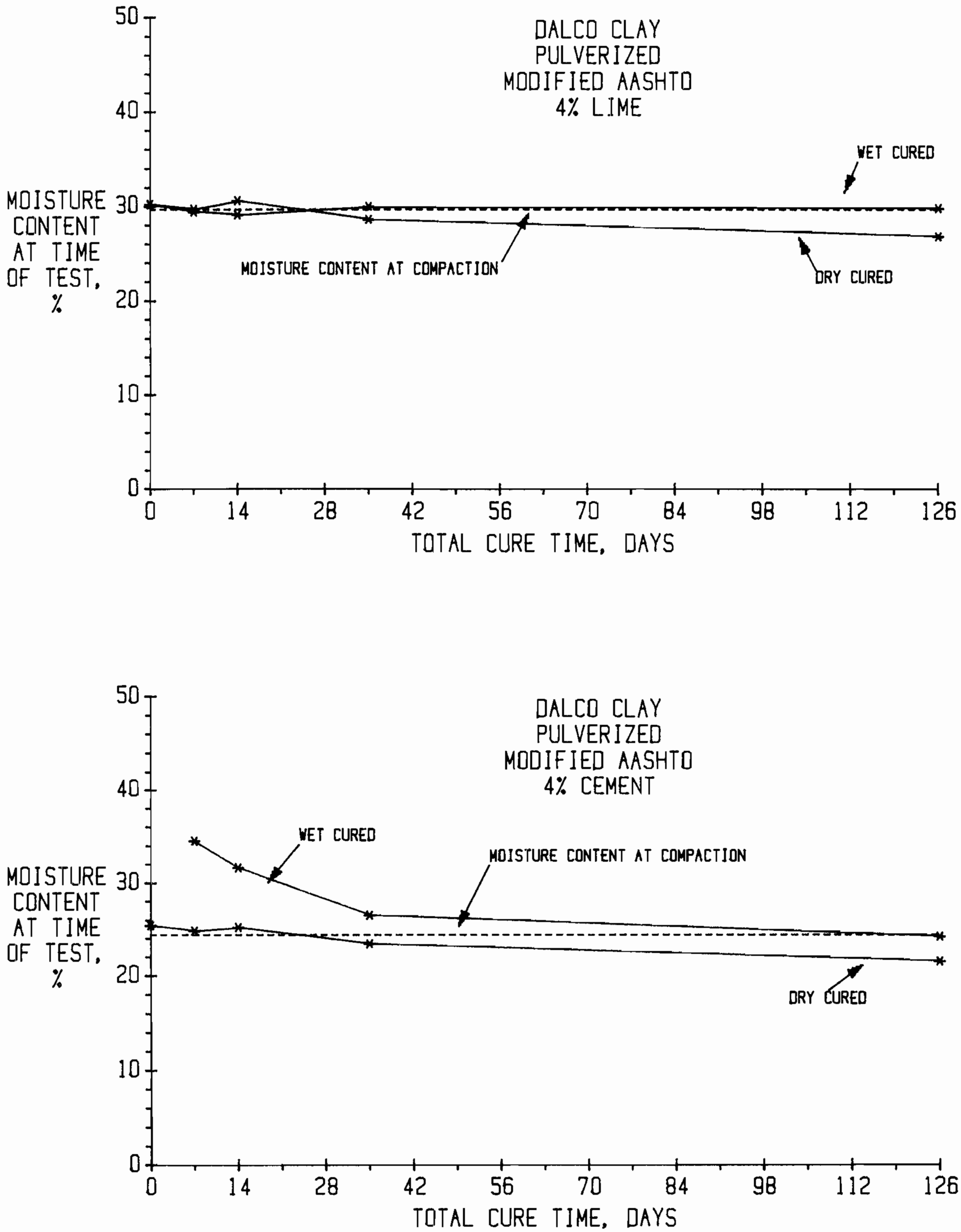


Fig 13. Relationships between moisture content and total curing time for pulverized Dalco clay treated with 4 percent lime and cement - modified AASHTO.

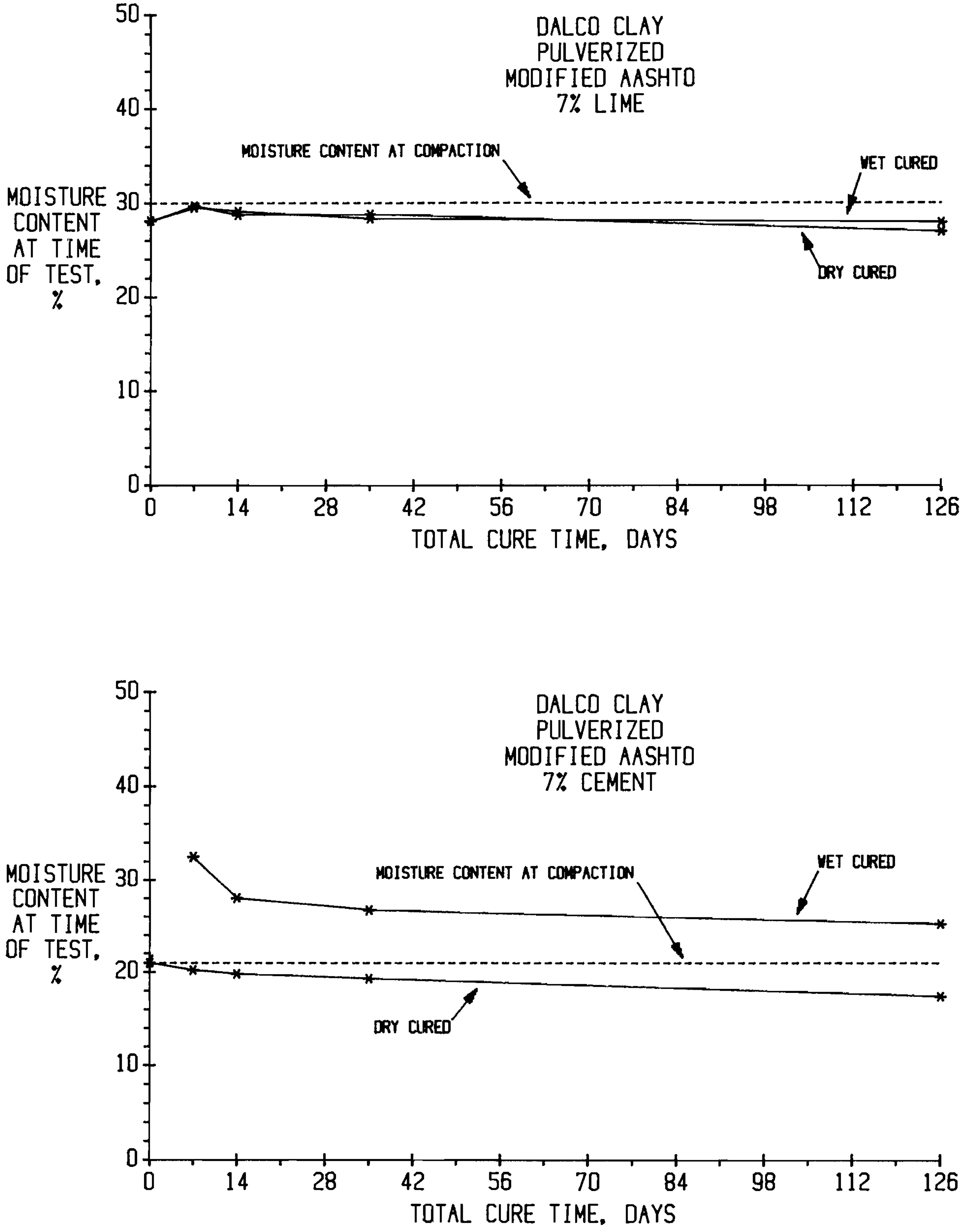
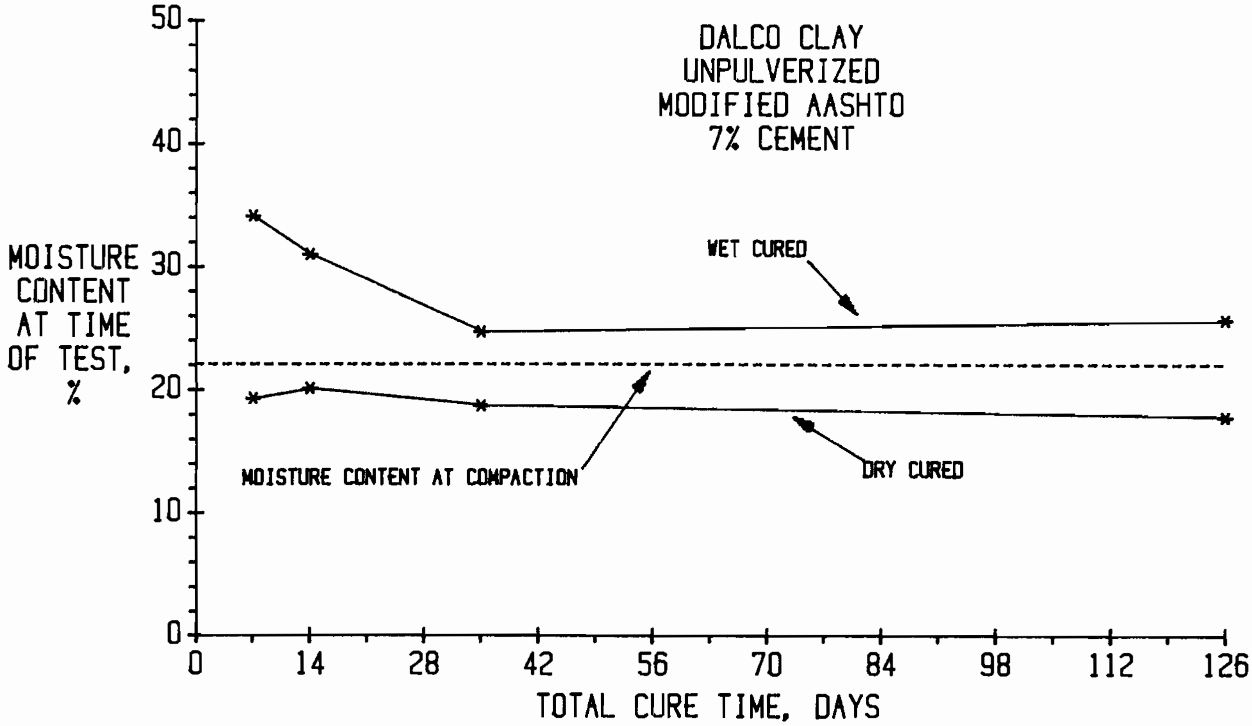


Fig 14. Relationships between changes in moisture content and total curing time for pulverized Dalco clay treated with 7 percent lime and cement-treated - modified AASHTO.



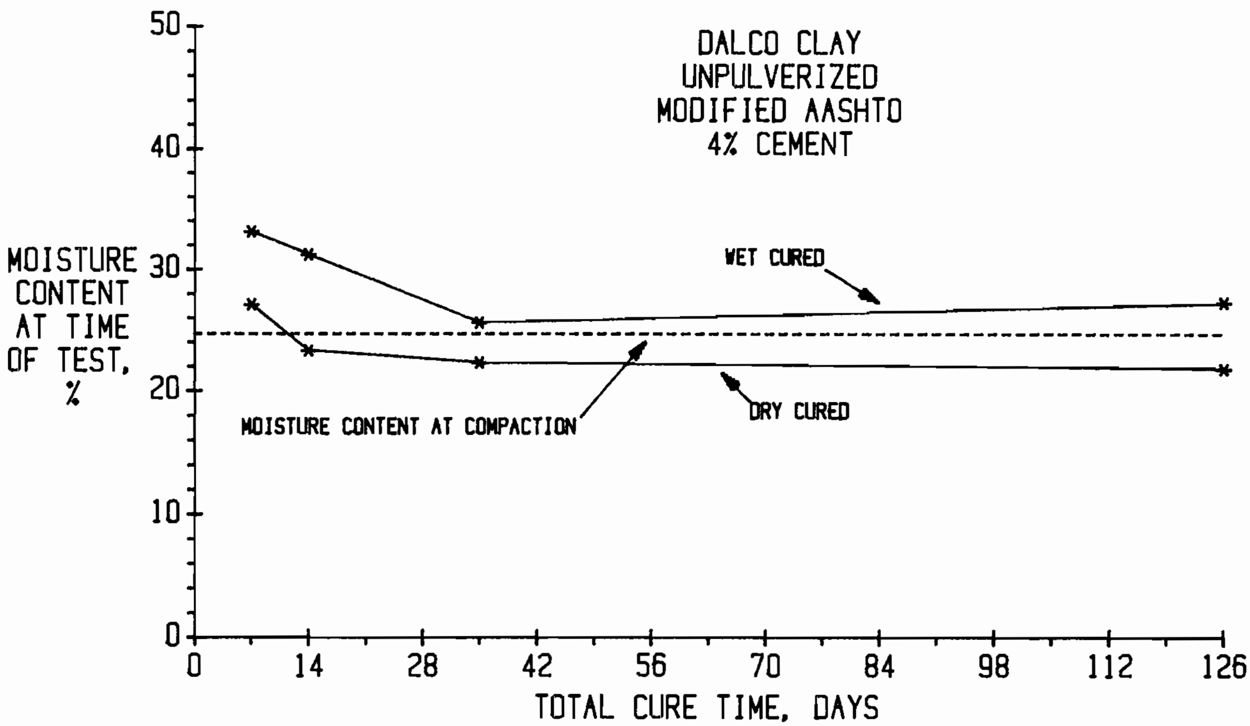
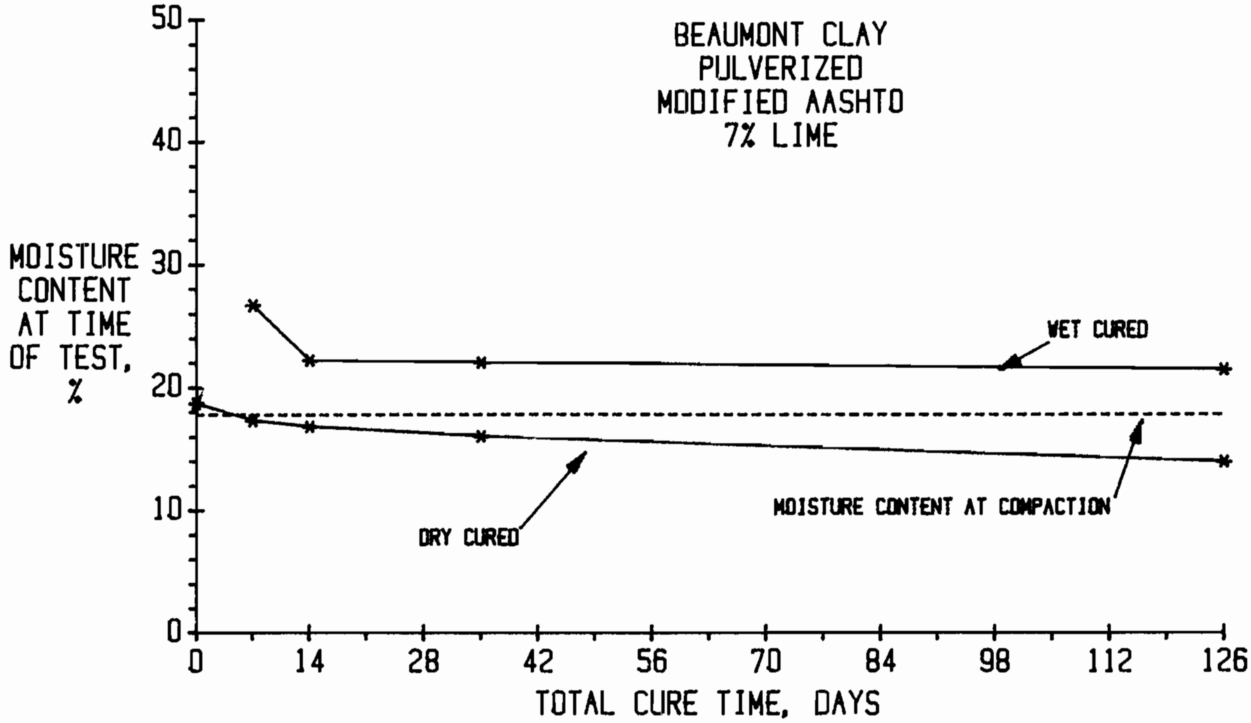


Fig 15. Relationships between changes in moisture content and total curing time for unpulverized Dalco clay treated with 7 percent and 4 percent cement - modified AASHTO.



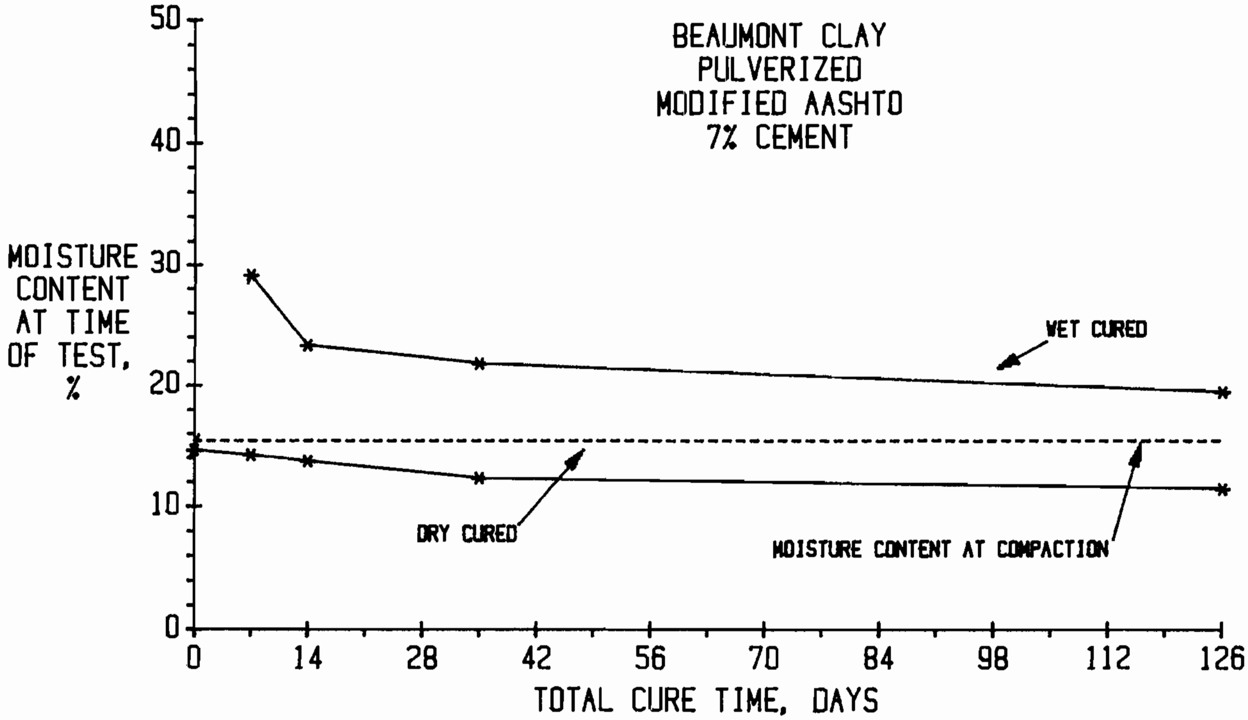


Fig 16. Relationships between changes in moisture content and total curing time for pulverized Beaumont clay treated with 7 percent lime and cement - modified AASHTO.

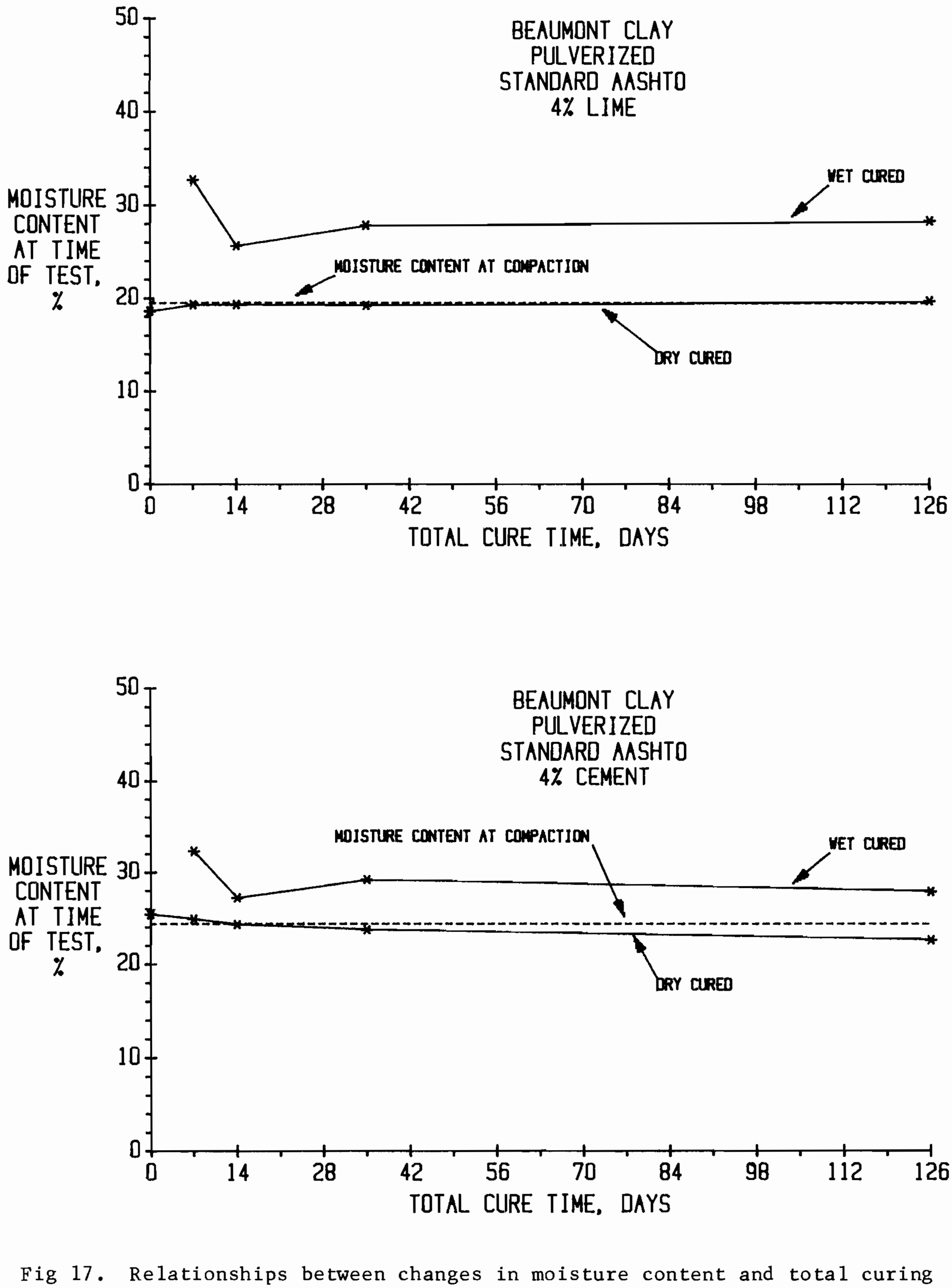
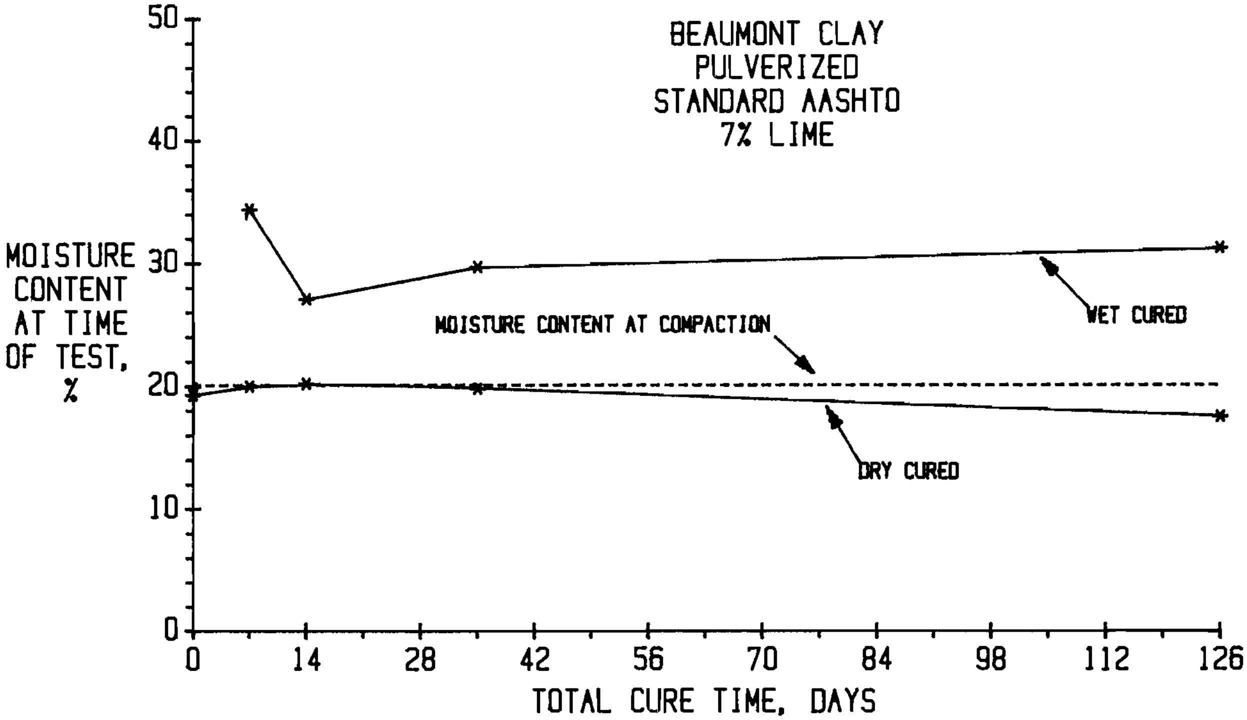


Fig 17. Relationships between changes in moisture content and total curing time for pulverized Beaumont clay treated with 4 percent lime - standard AASHTO.



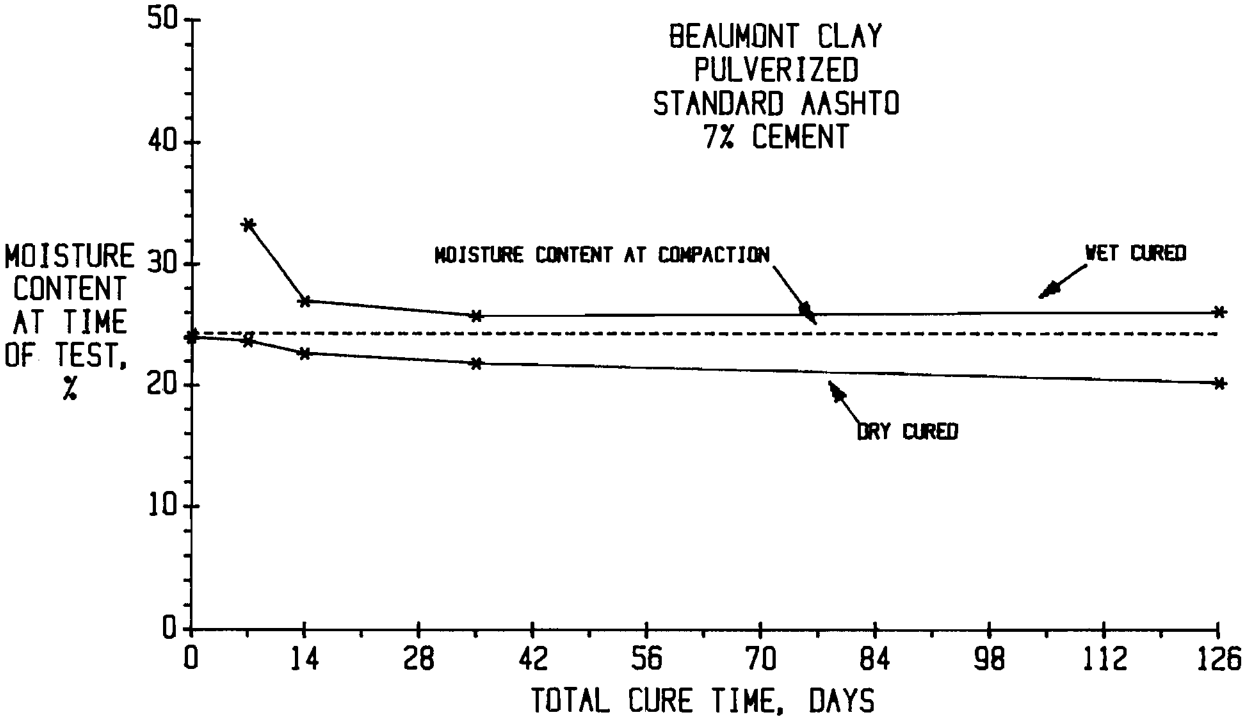
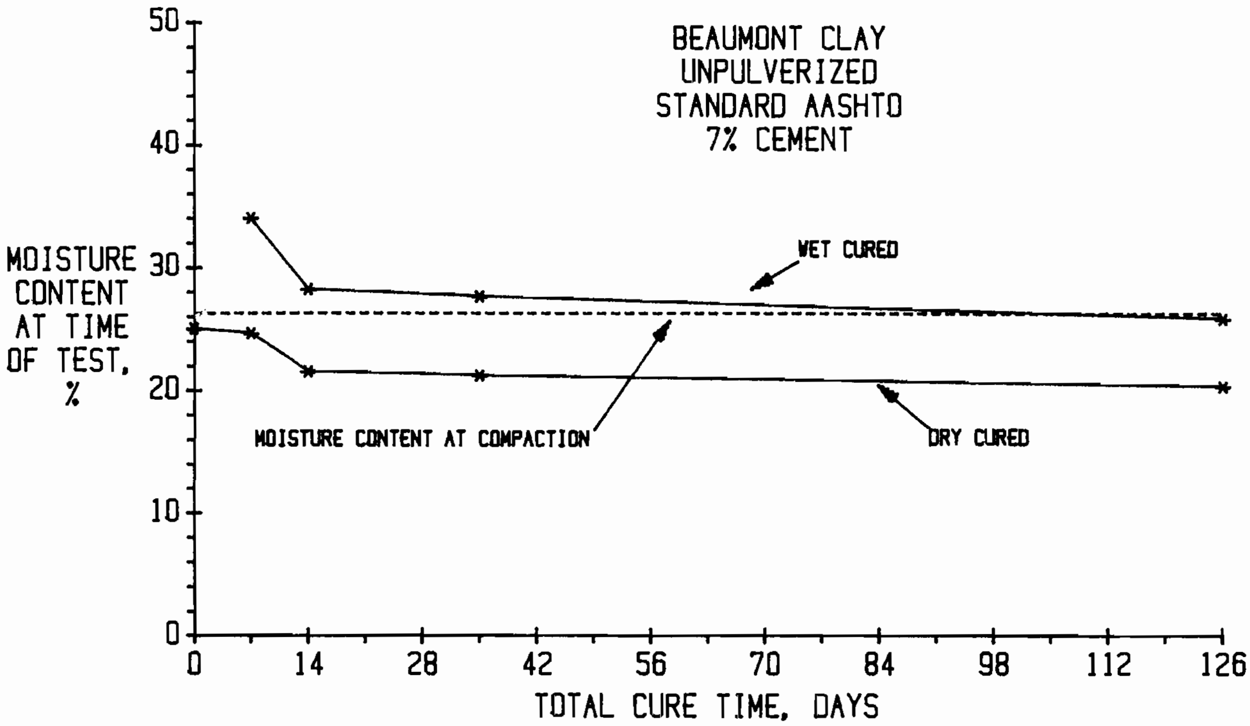


Fig 18. Relationships between changes in moisture content and total curing time for pulverized Beaumont clay treated with 4 percent lime - standard AASHTO.



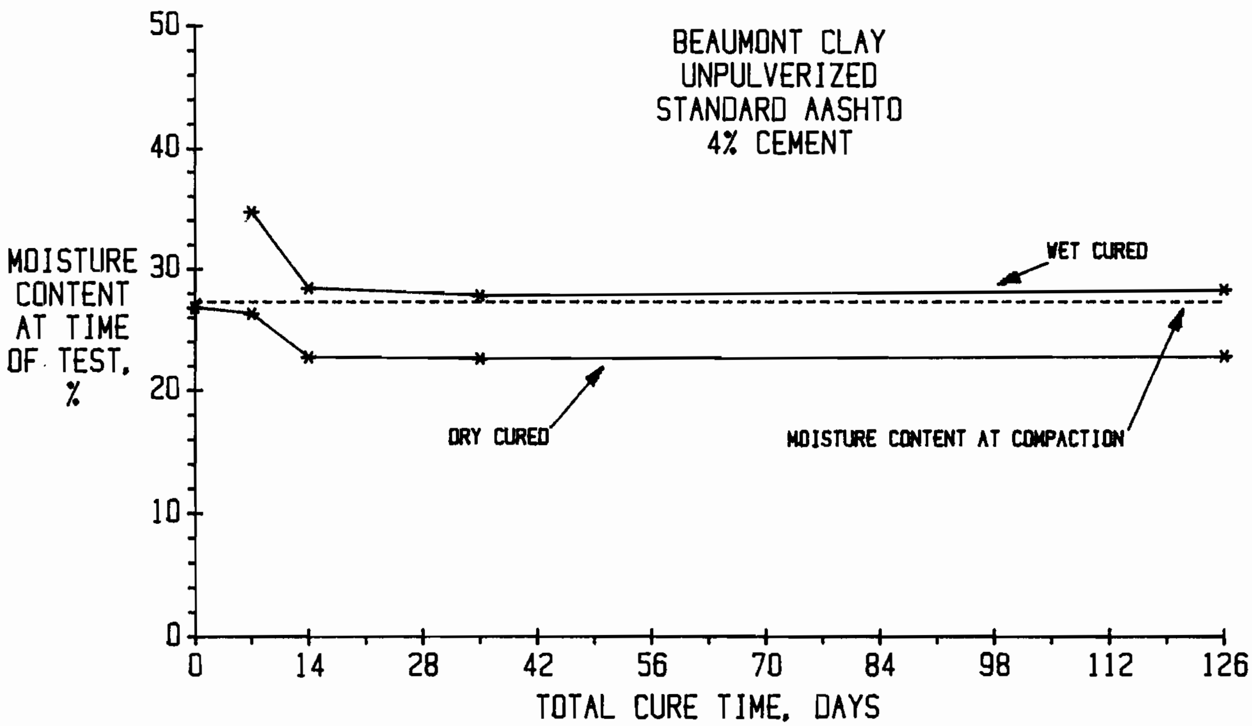
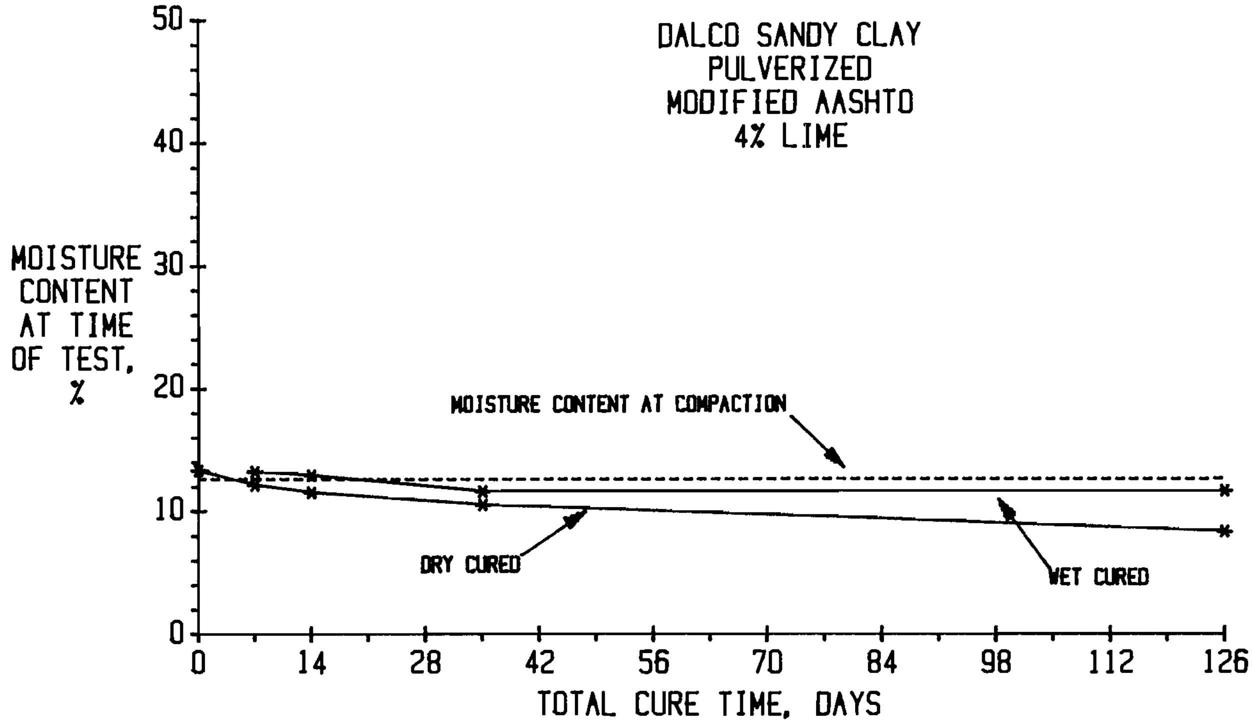


Fig 19. Relationships between changes in moisture content and total curing time for unpulverized Beaumont clay treated with 7 and 4 percent cement - standard AASHTO.



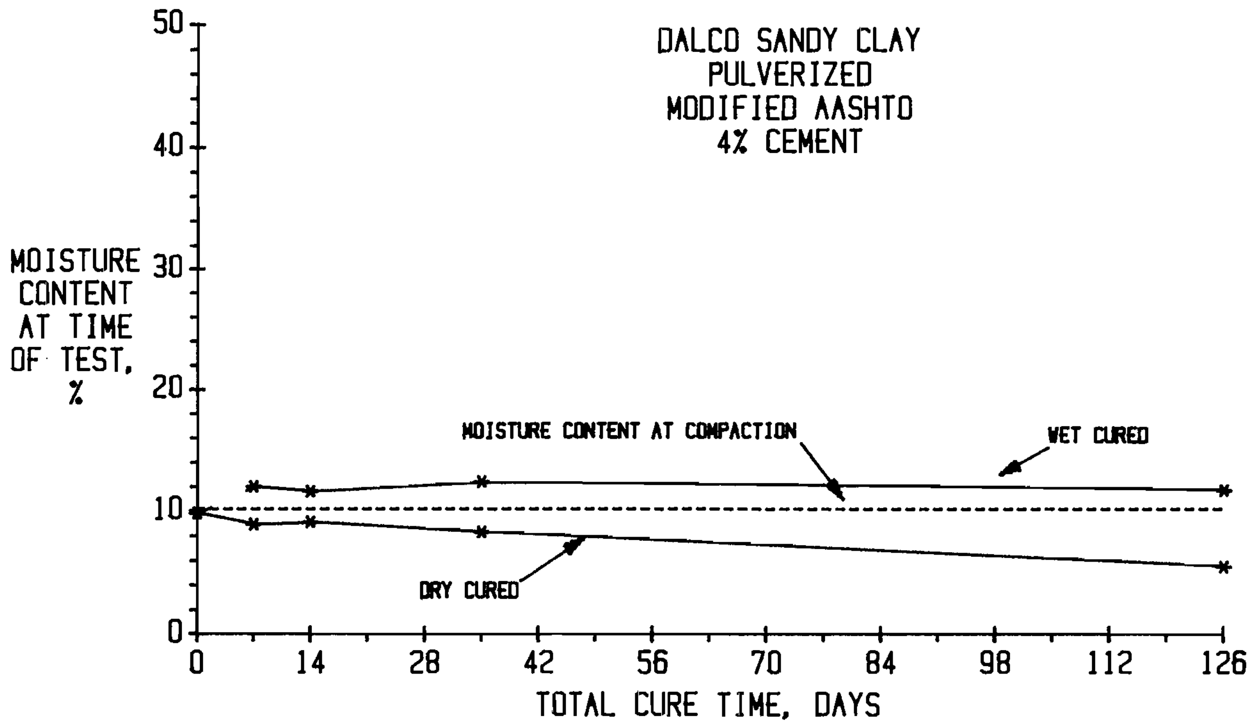
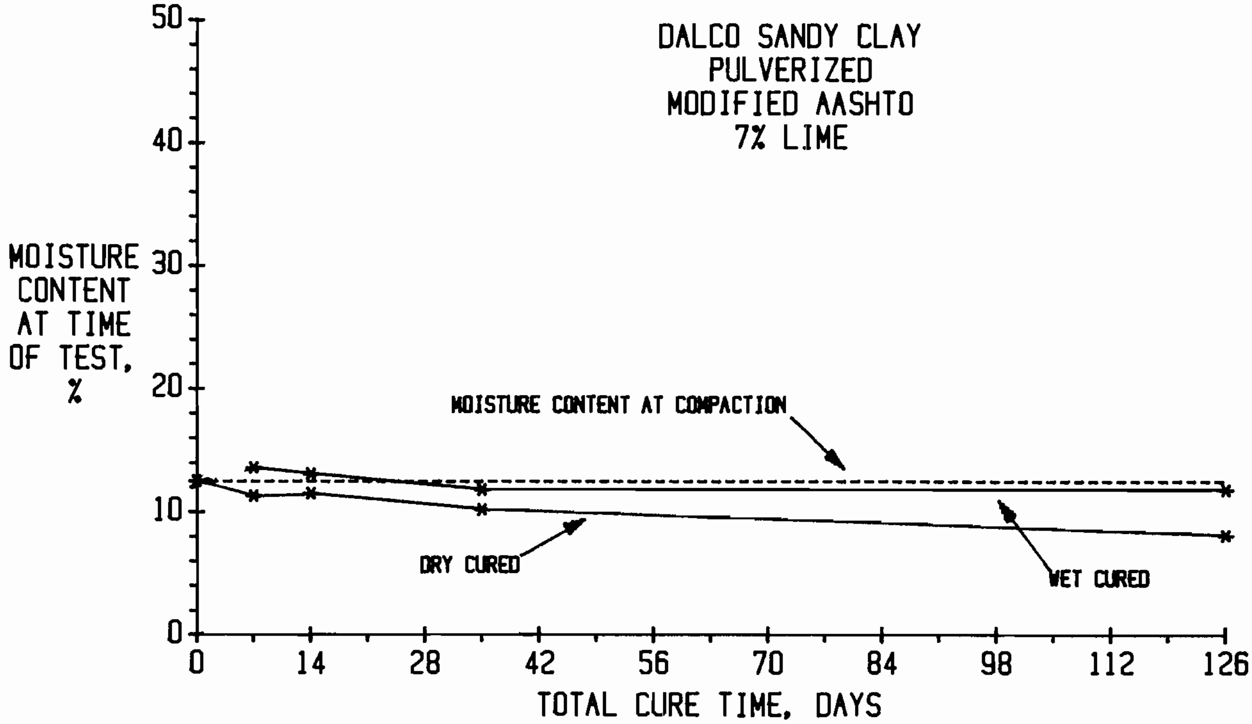


Fig 20. Relationships between changes in moisture content and total curing time for pulverized Dalco sandy clay treated with 4 percent lime and cement - modified AASHTO.



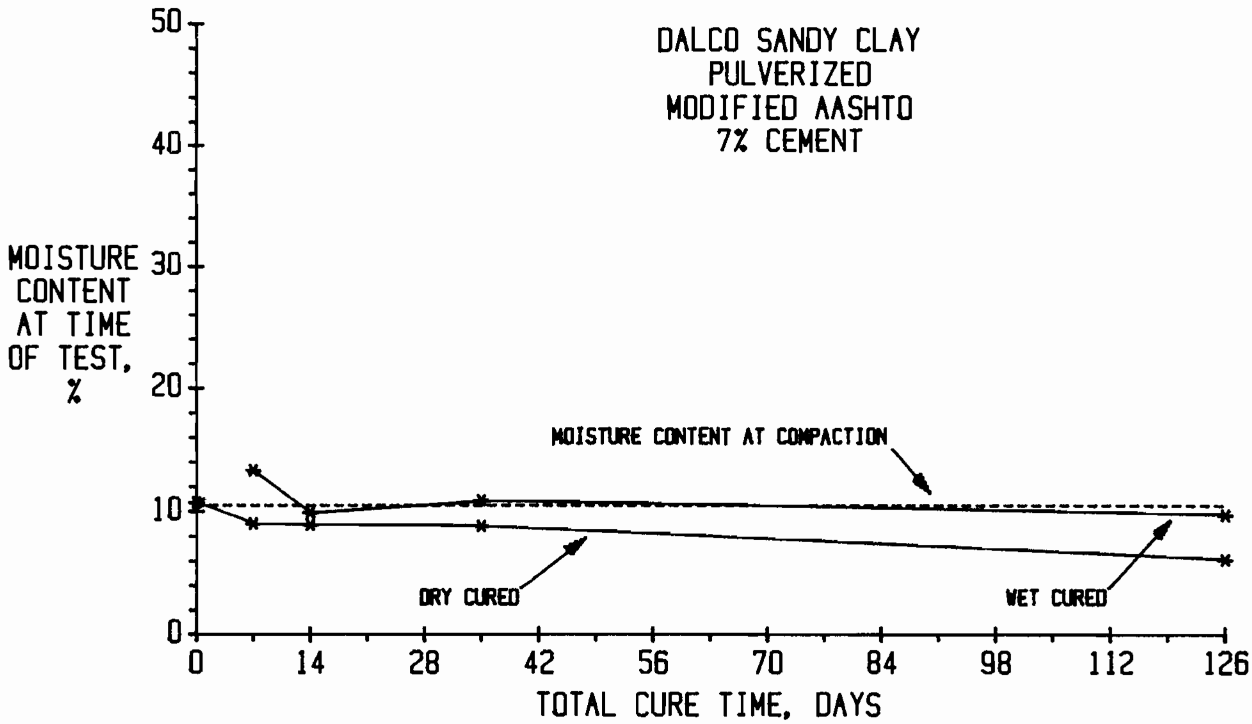
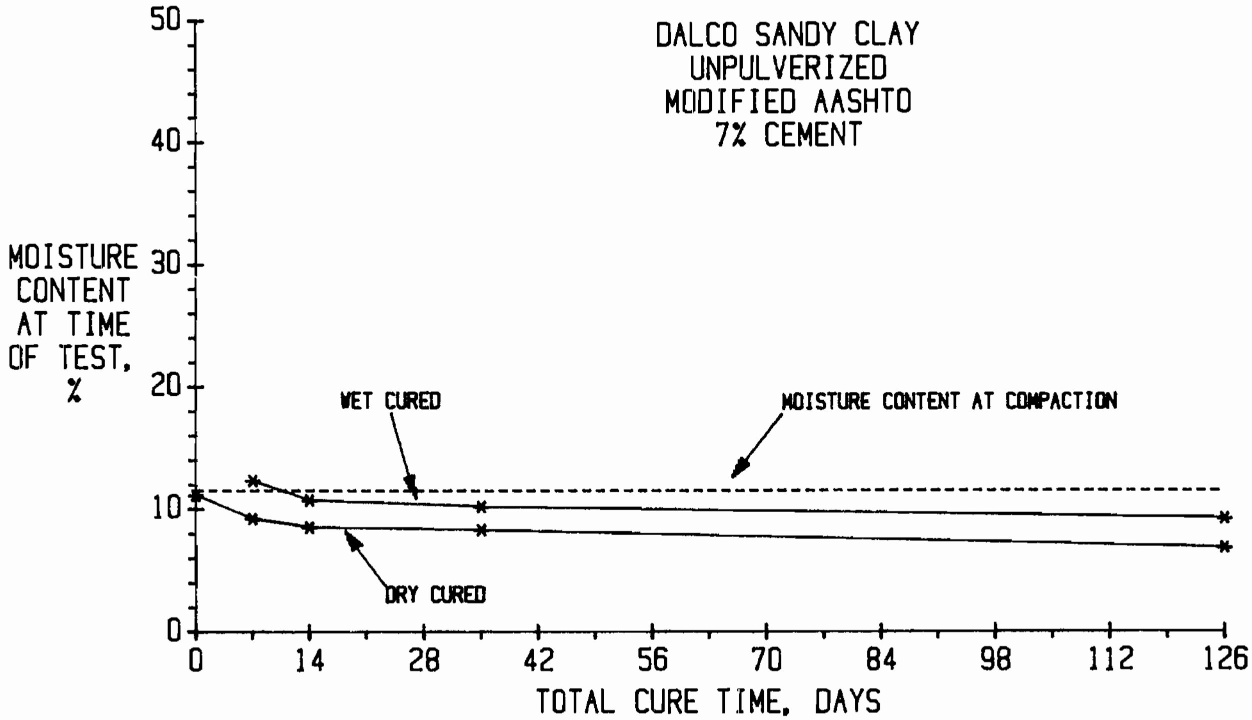


Fig 21. Relationships between changes in moisture content and total curing time for pulverized Dalco sandy clay treated with 7 percent lime and cement - modified AASHTO.



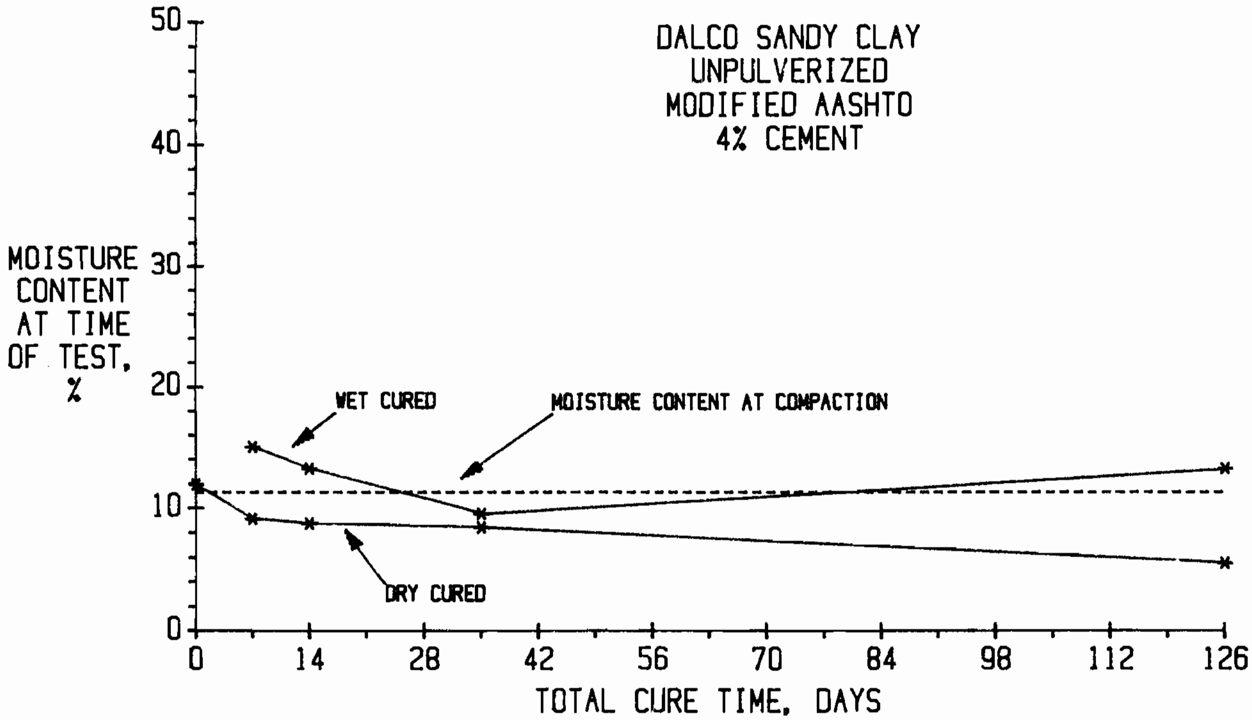


Fig 22. Relationships between changes in moisture content and total curing time for unpulverized Dalco sandy clay treated with 7 and 4 percent cement - modified AASHTO.

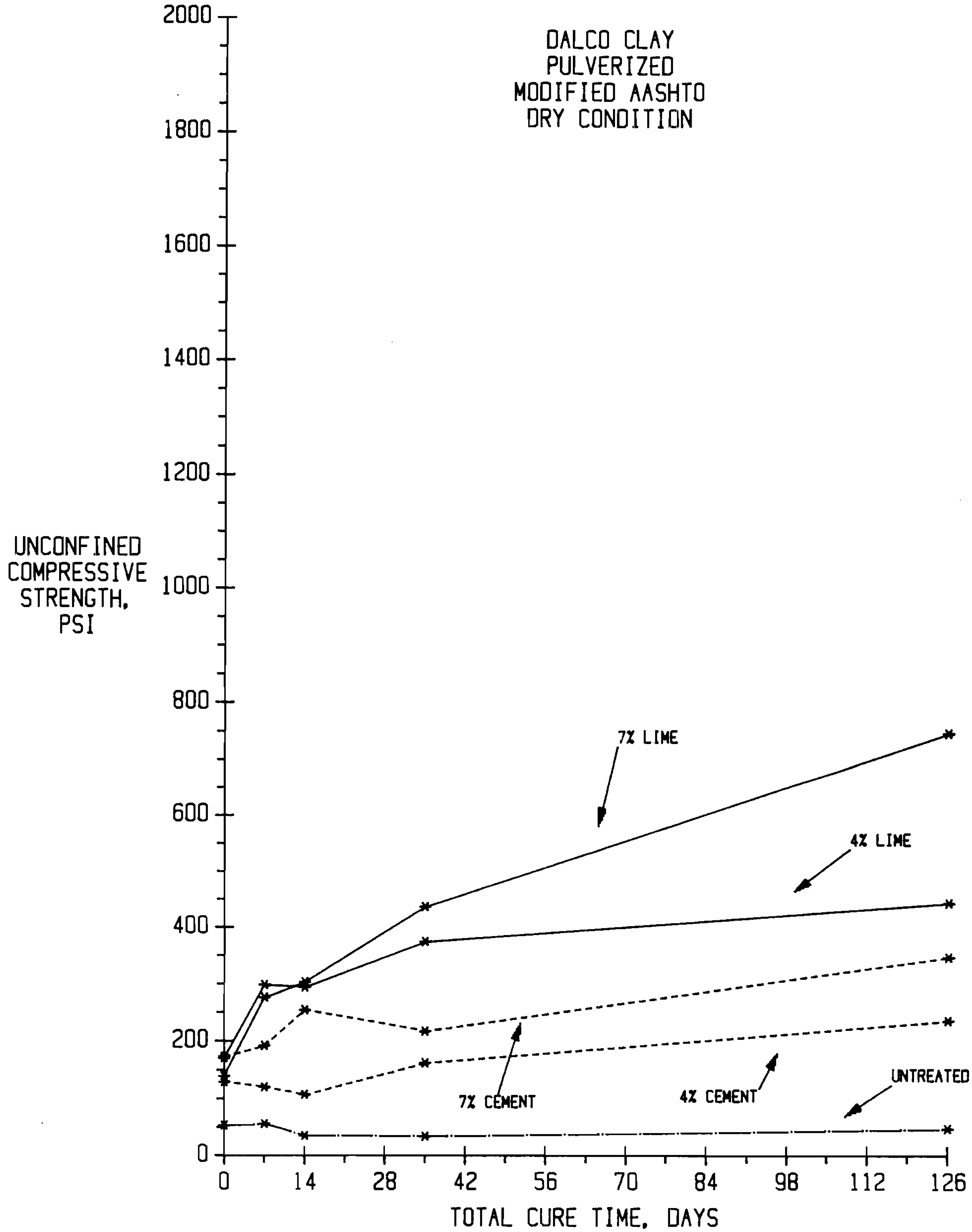


Fig 23. Dry unconfined compressive strength for pulverized Dalco clay, treated with cement or lime.

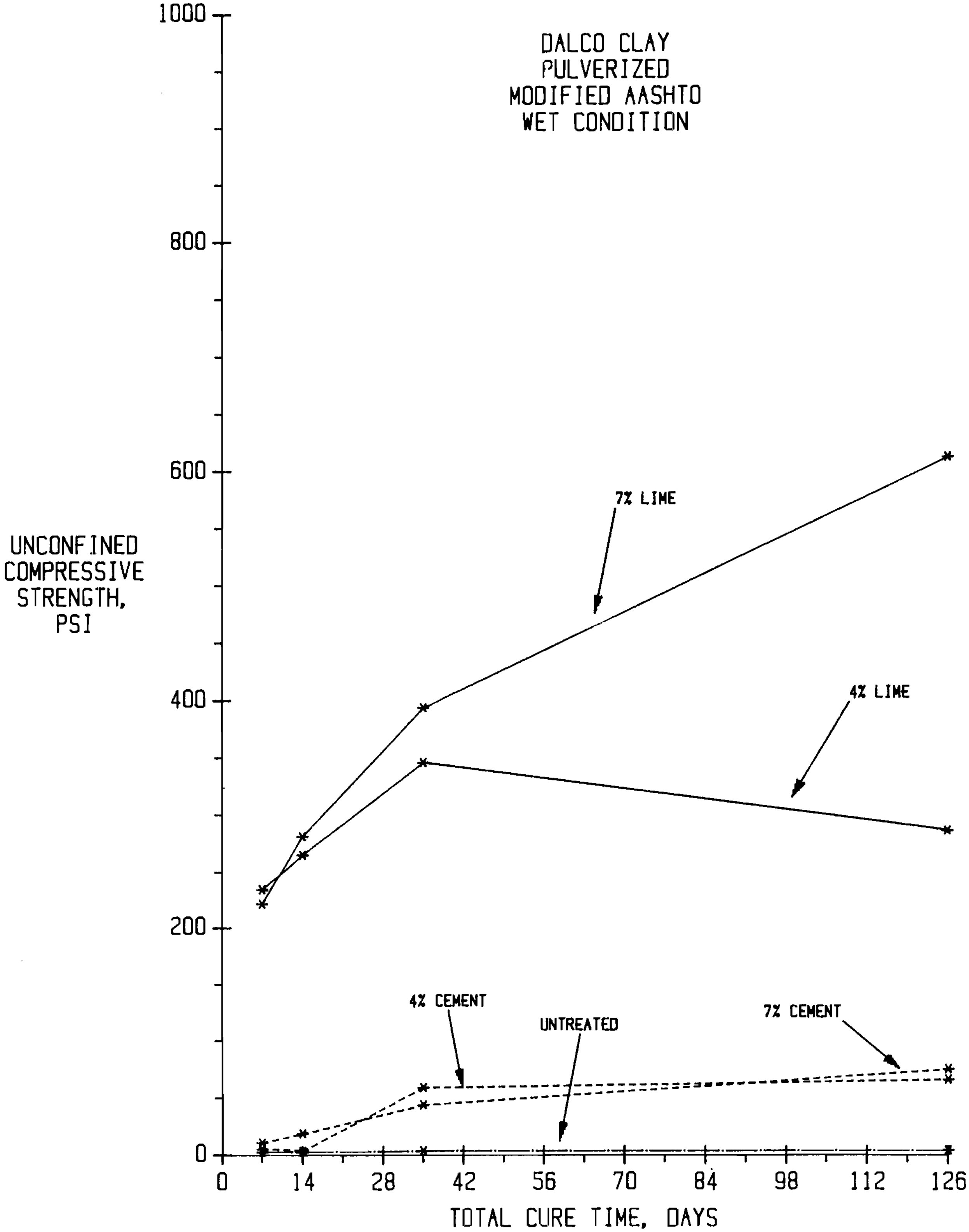


Fig 24. Wet unconfined compressive strength for pulverized Dalco clay, treated with cement or lime.

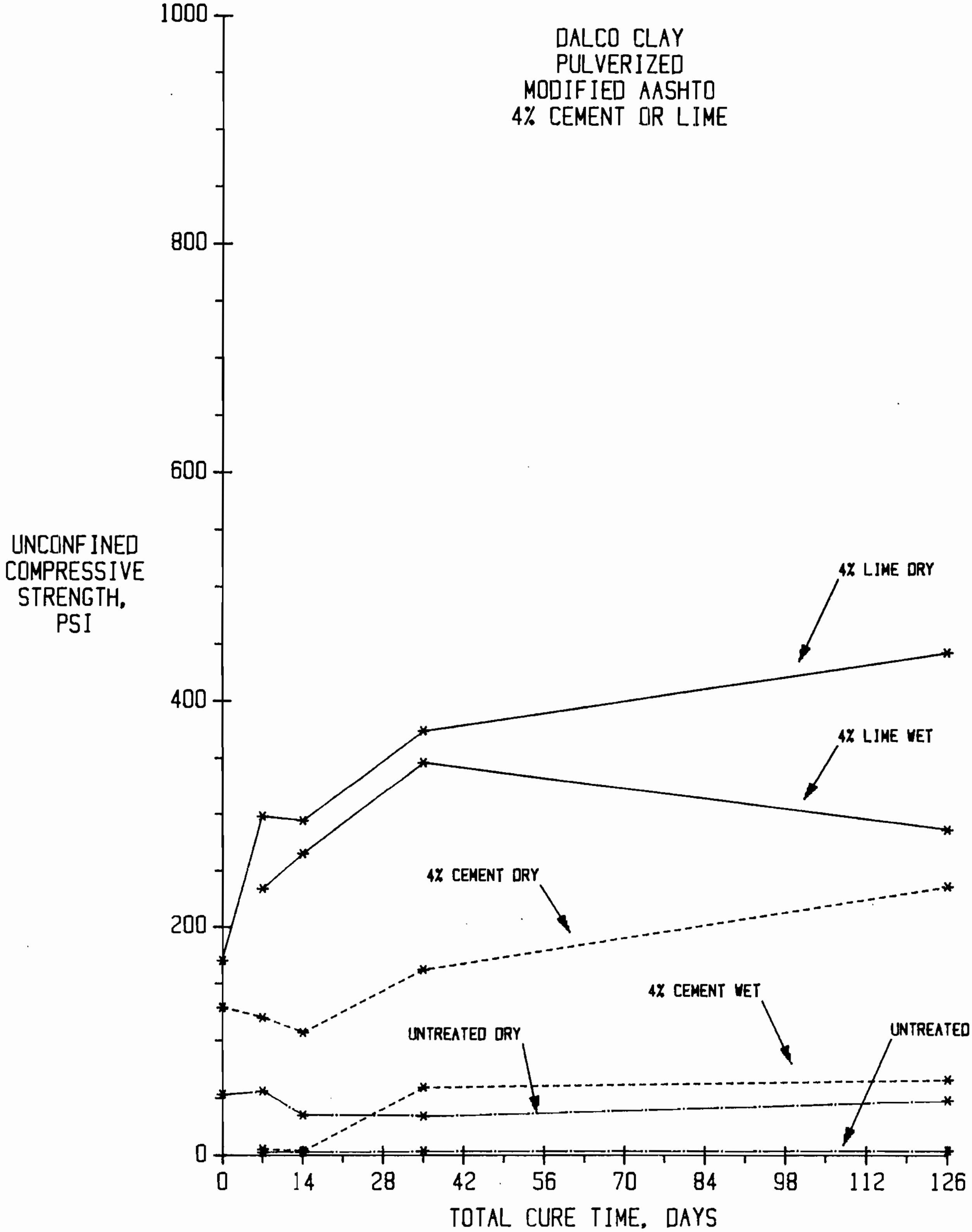


Fig 25. Dry and wet unconfined compressive strengths for 4 percent cement and lime treated, pulverized Dalco clay - modified AASHTO.

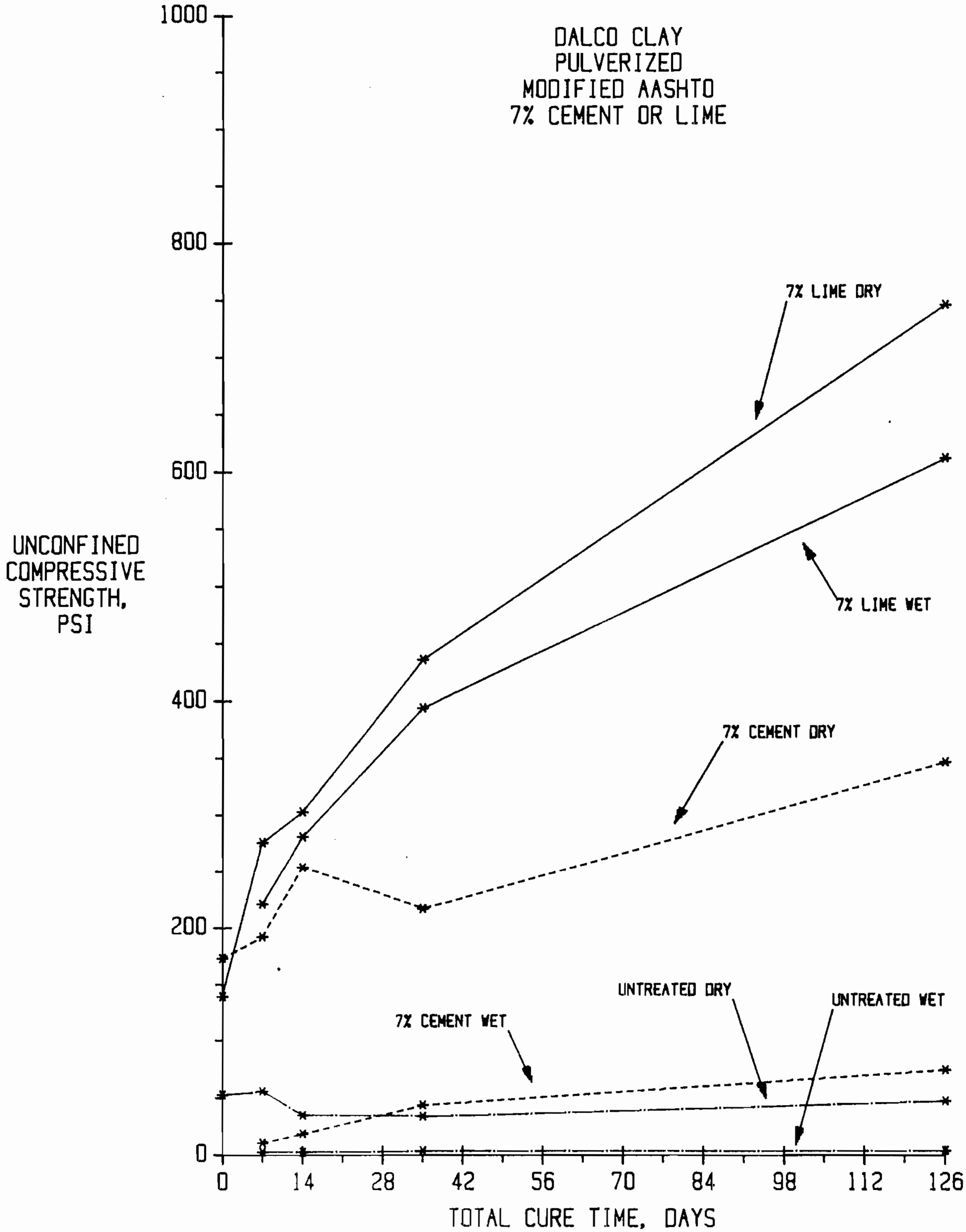


Fig 26. Dry and wet unconfined compressive strengths for 7 percent cement and lime treated, pulverized Dalco clay - modified AASHTO.

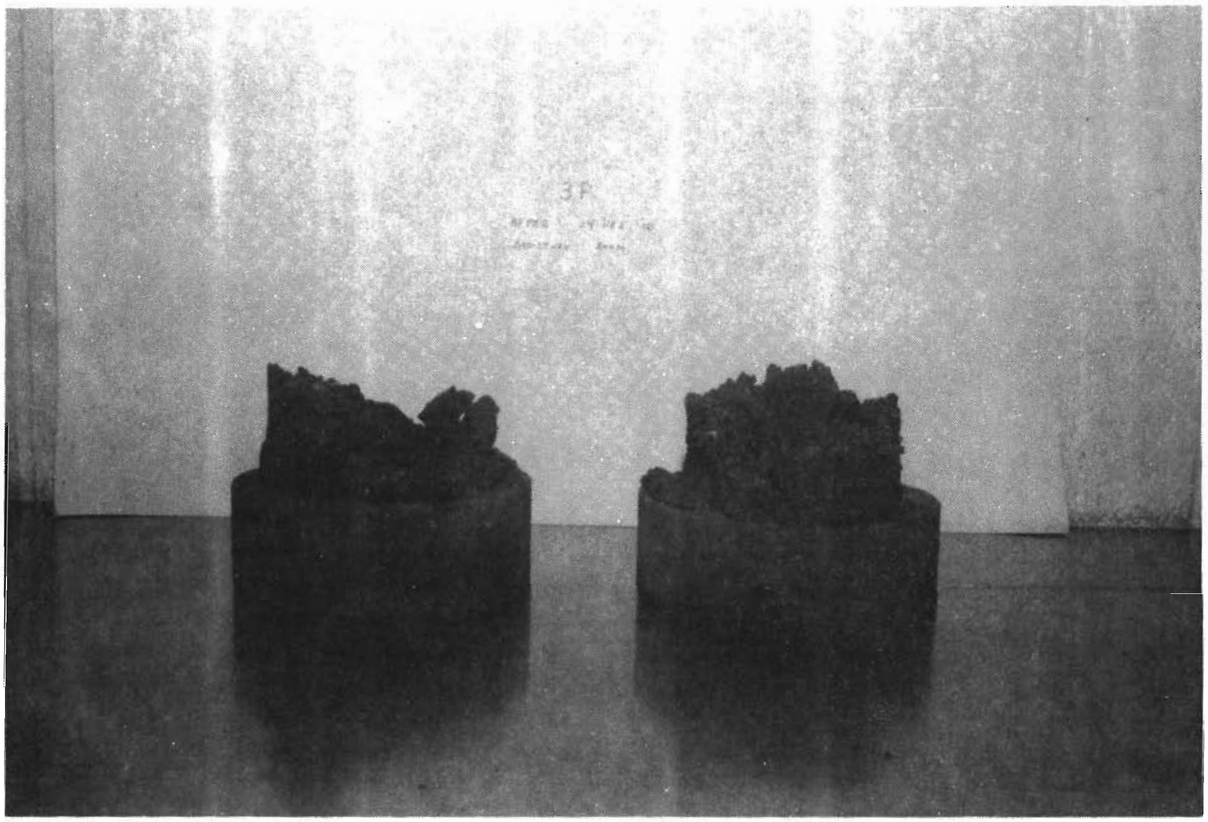


Fig 27. Wet cement-treated specimens after curing.

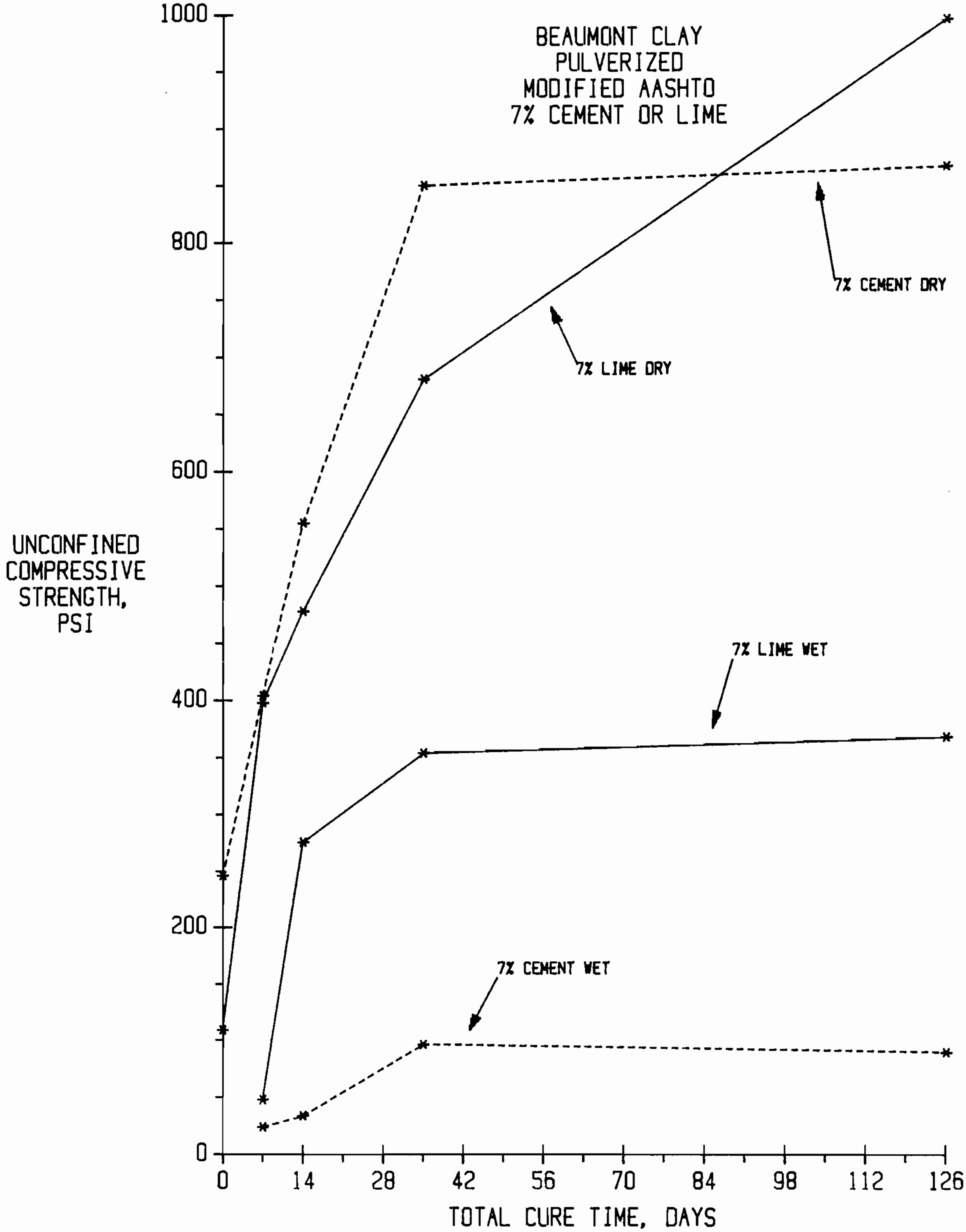


Fig 28. Dry and wet unconfined compressive strengths for 7 percent cement and lime treated, pulverized Beaumont clay - modified AASHTO.

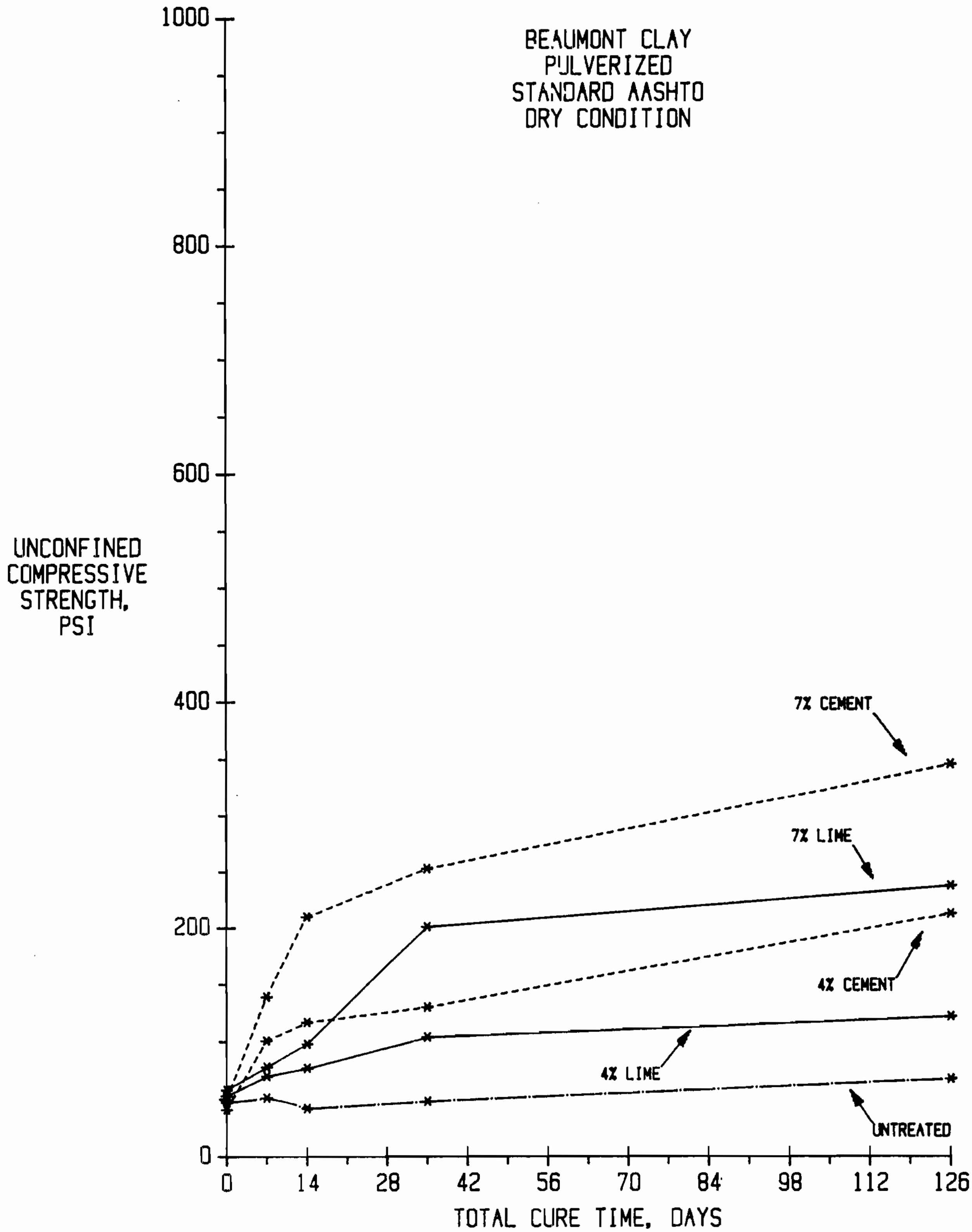


Fig 29. Dry unconfined compressive strengths for pulverized Beaumont clay, treated with cement or lime.

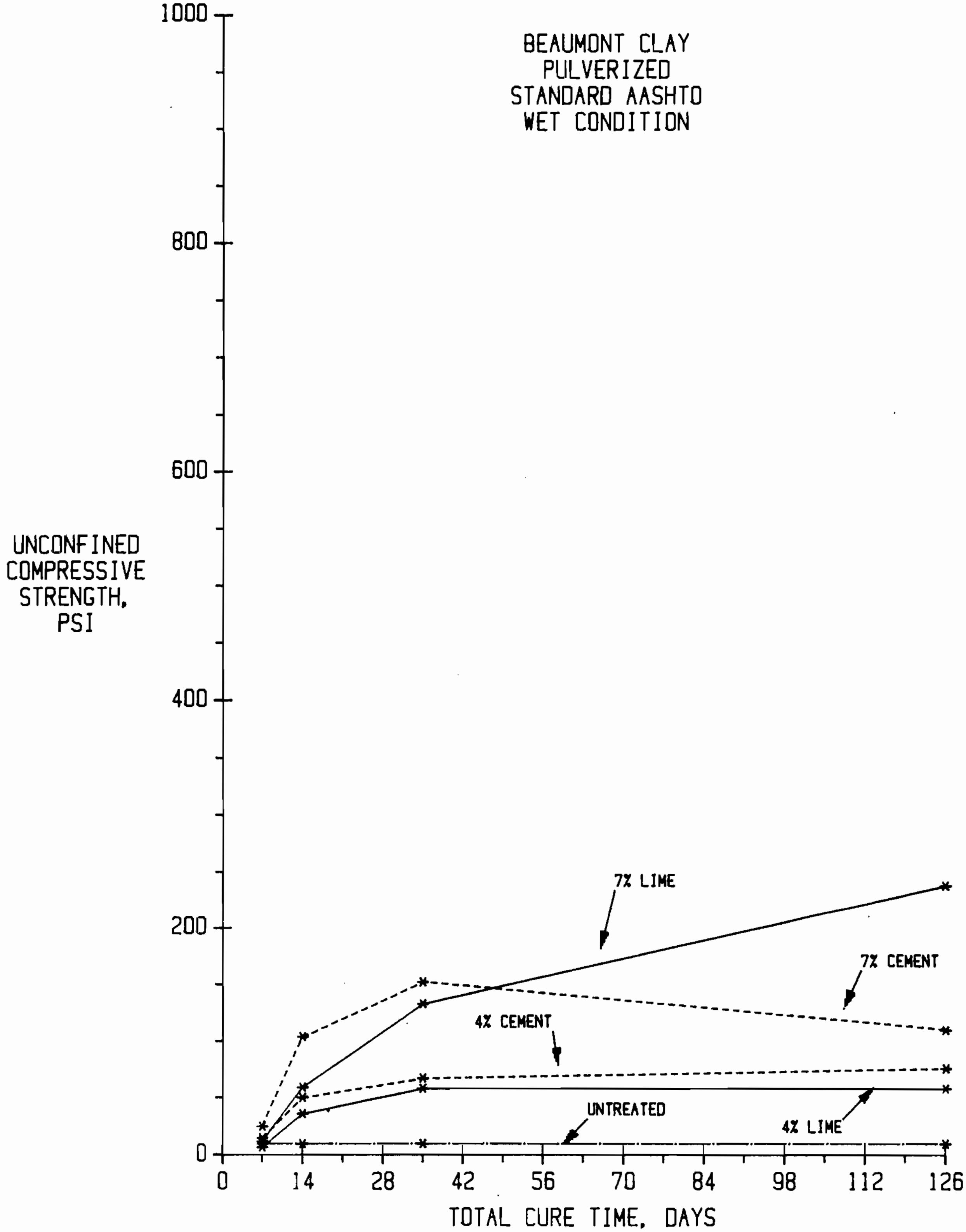


Fig 30. Wet unconfined compressive strength for pulverized Beaumont clay, treated with cement or lime.

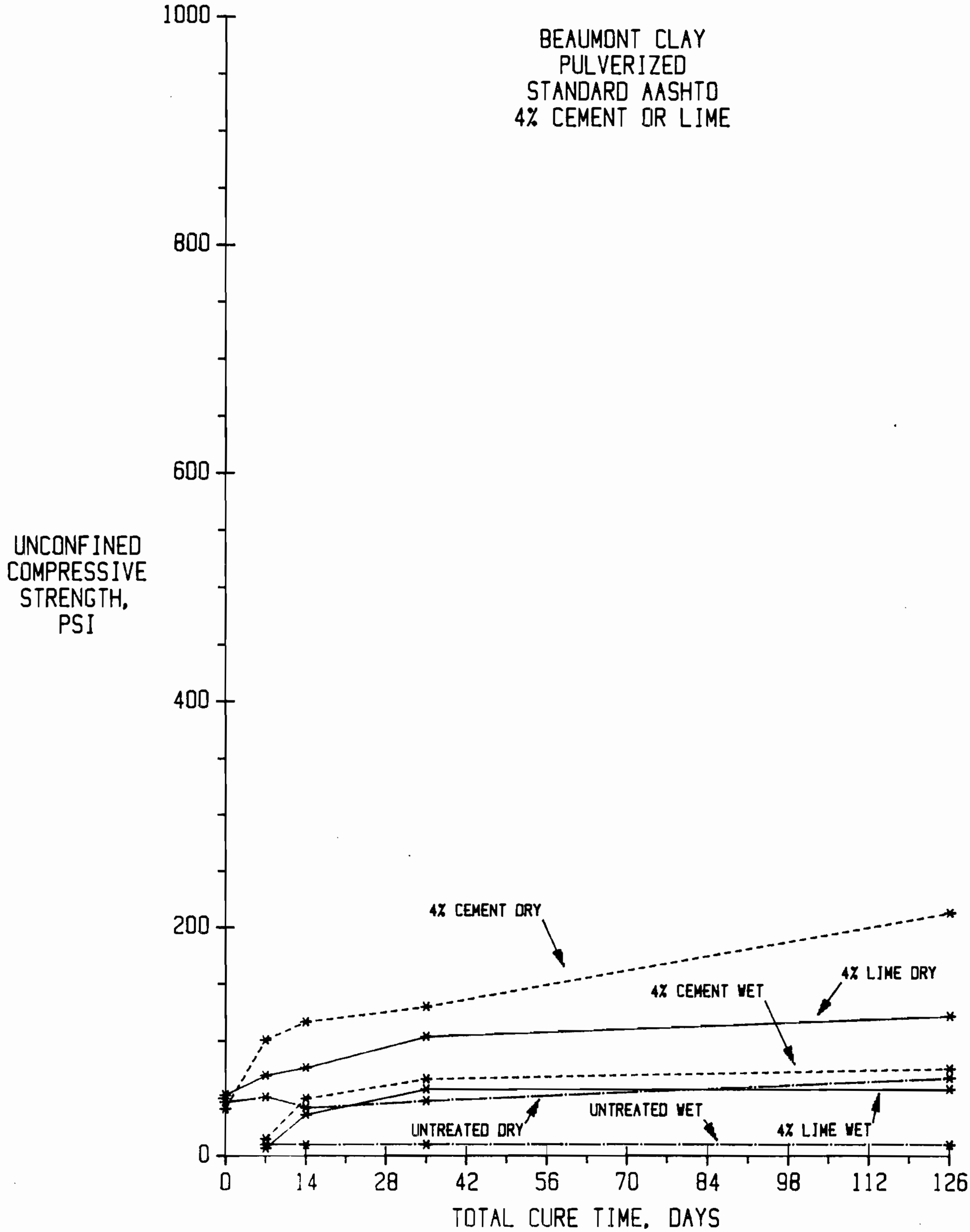


Fig 31. Dry and wet unconfined compressive strengths for 4 percent cement and lime treated, pulverized Beaumont clay - standard AASHTO.

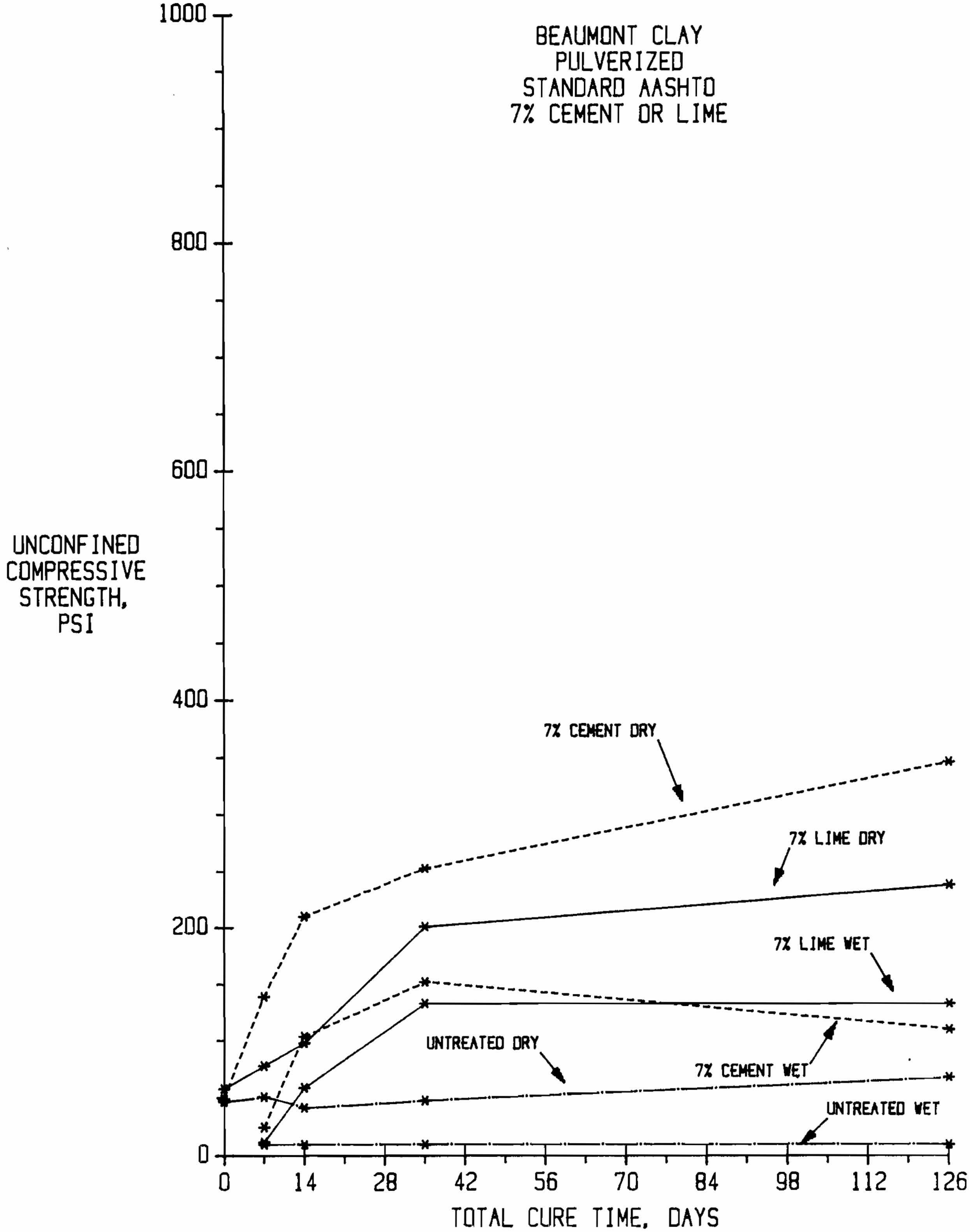


Fig 32. Dry and wet unconfined compressive strengths for 7 percent cement and lime treated, pulverized Beaumont clay - standard AASHTO.

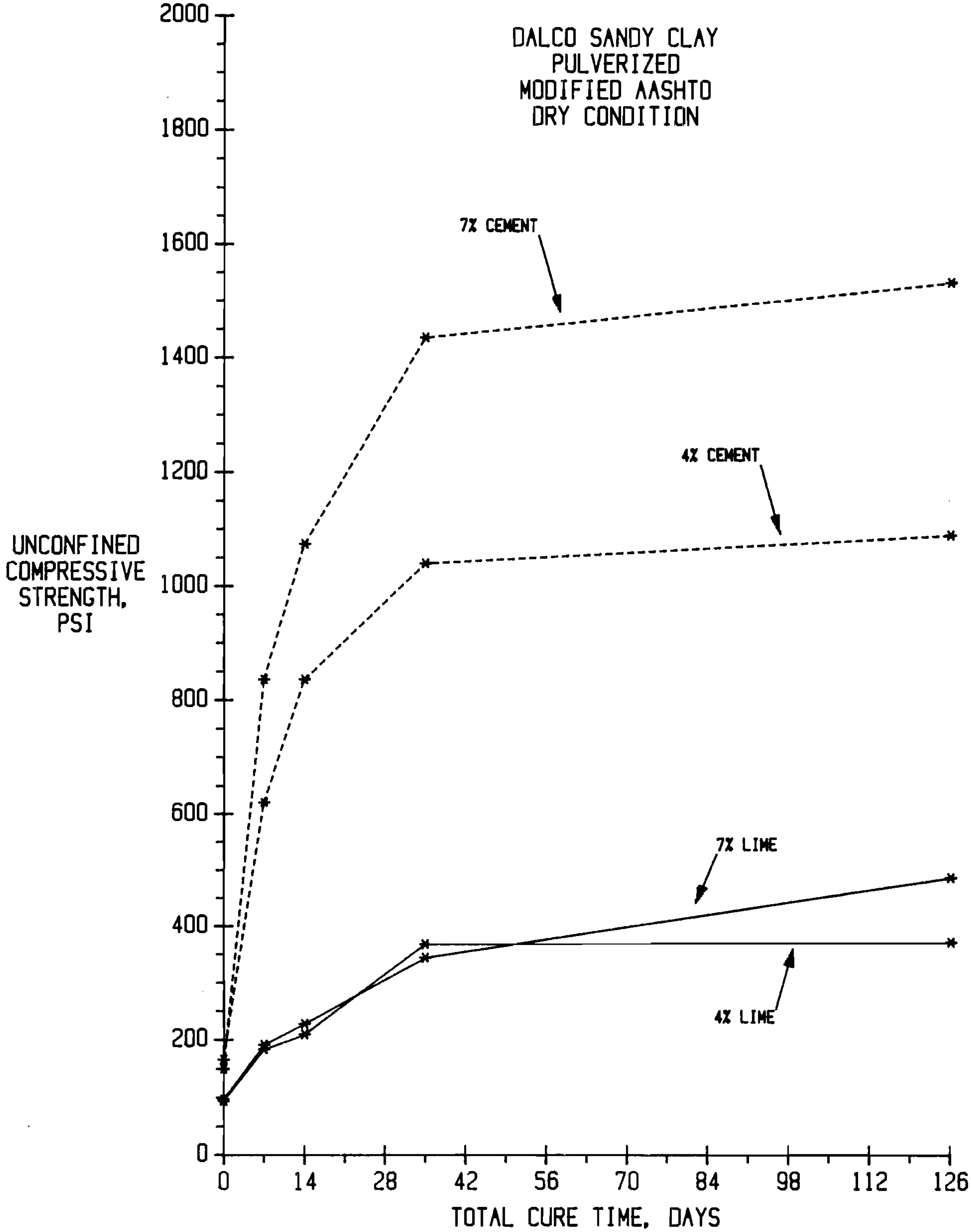


Fig 33. Dry unconfined compressive strength for pulverized Dalco sandy clay, treated with cement or lime.

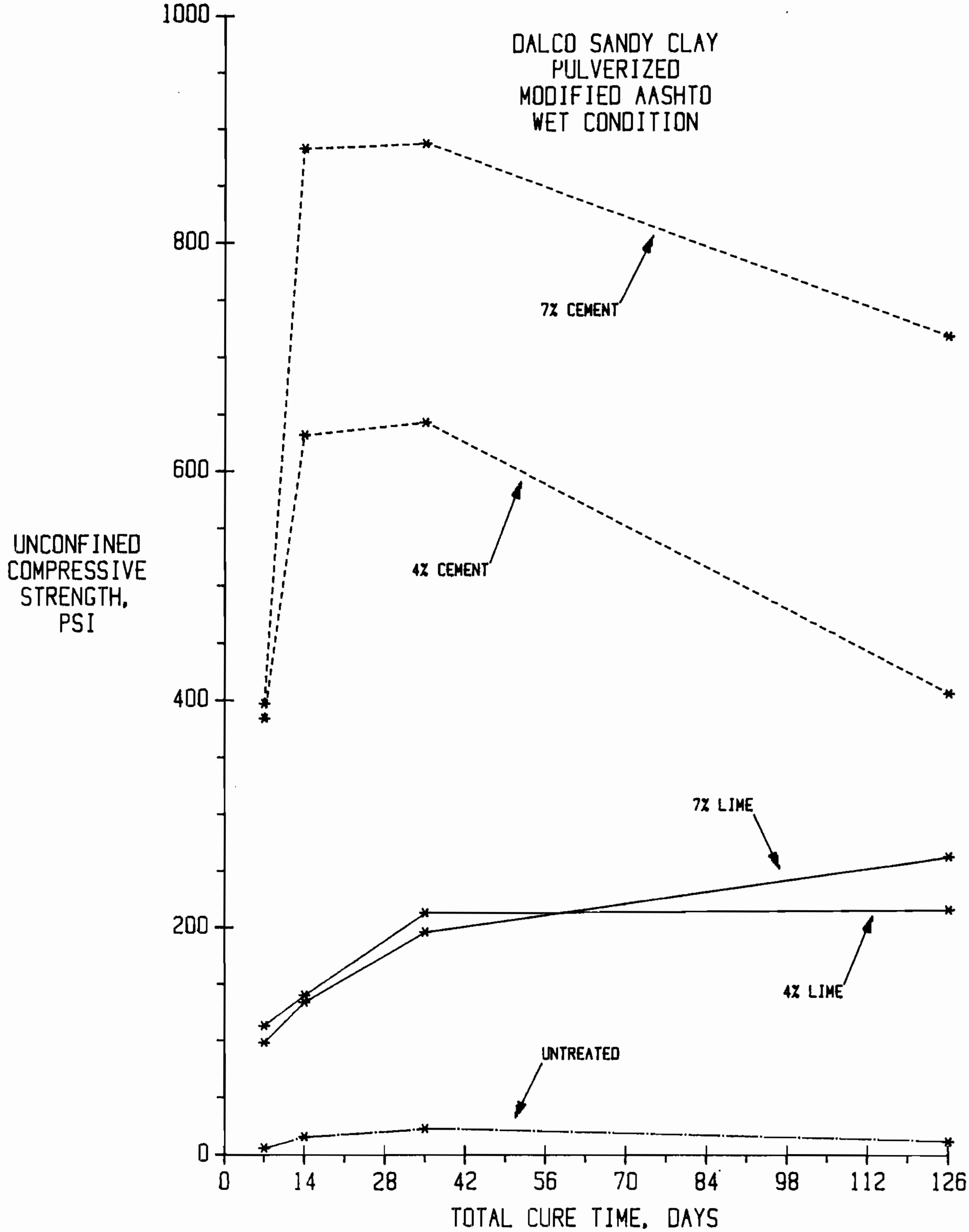


Fig 34. Wet unconfined compressive strength for pulverized Dalco sandy clay, treated with cement or lime.

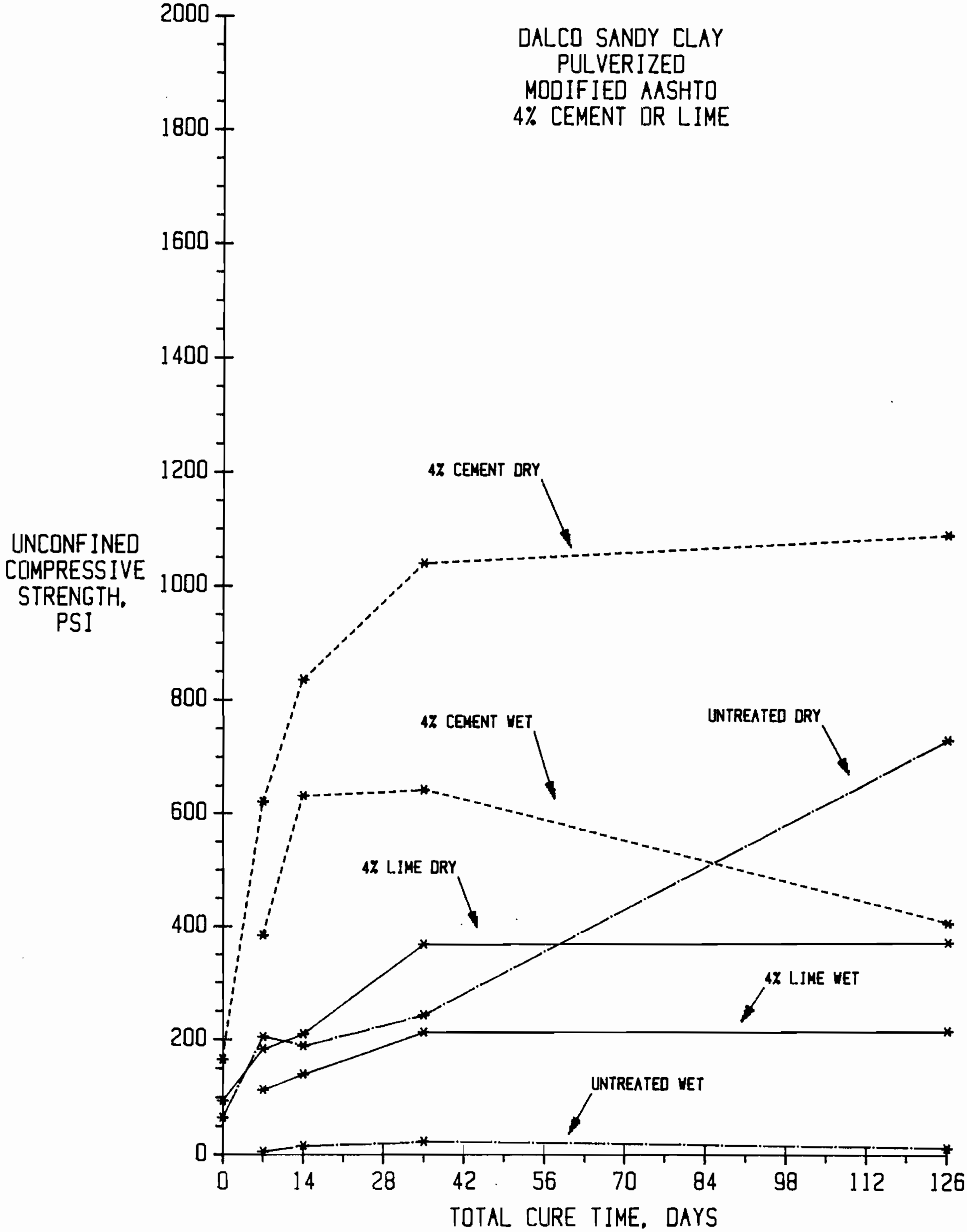


Fig 35. Unconfined compressive strength for pulverized Dalco sandy clay treated with 4 percent cement and lime.

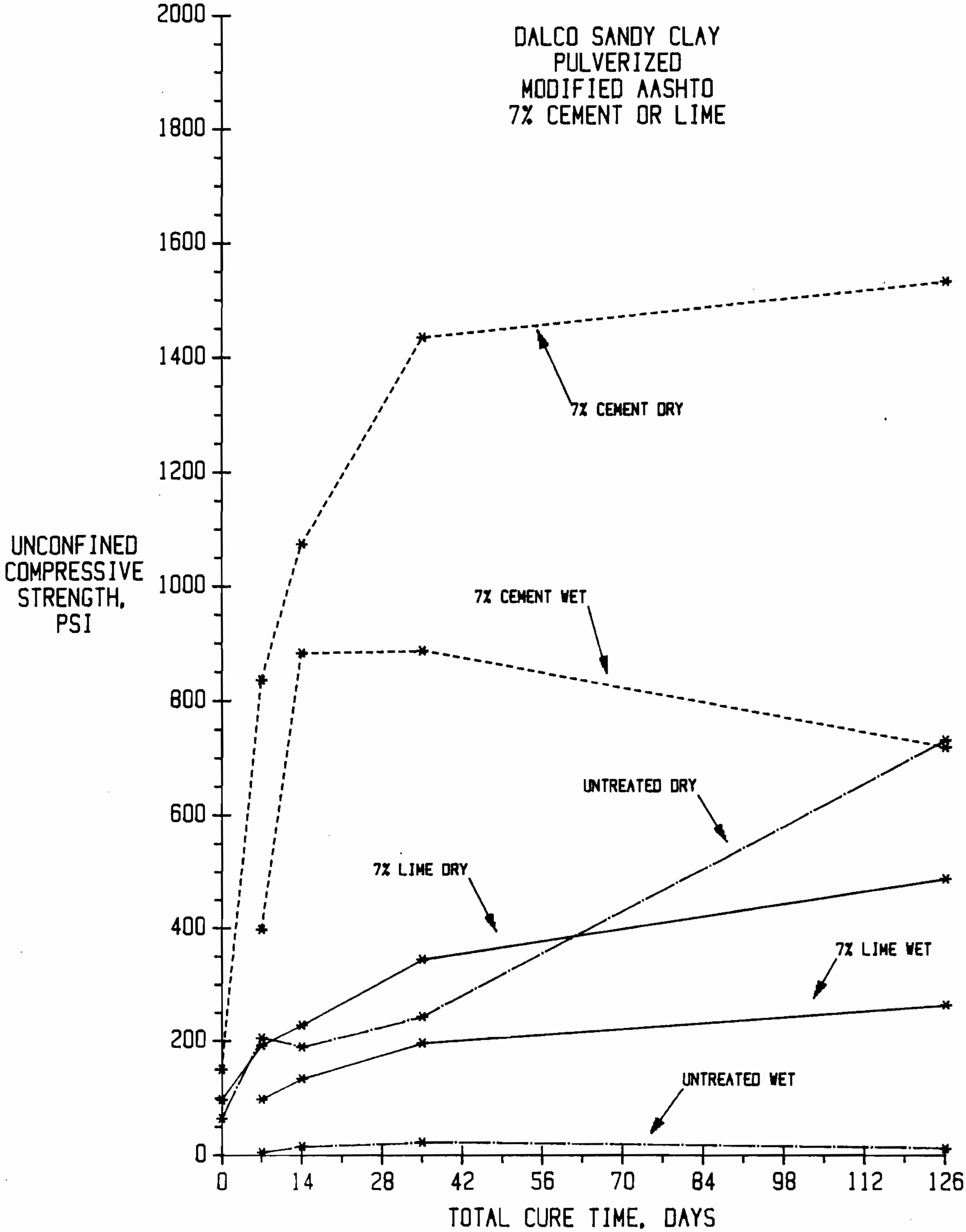


Fig 36. Unconfined compressive strength for pulverized Dalco sandy clay treated with 7 percent cement and lime.

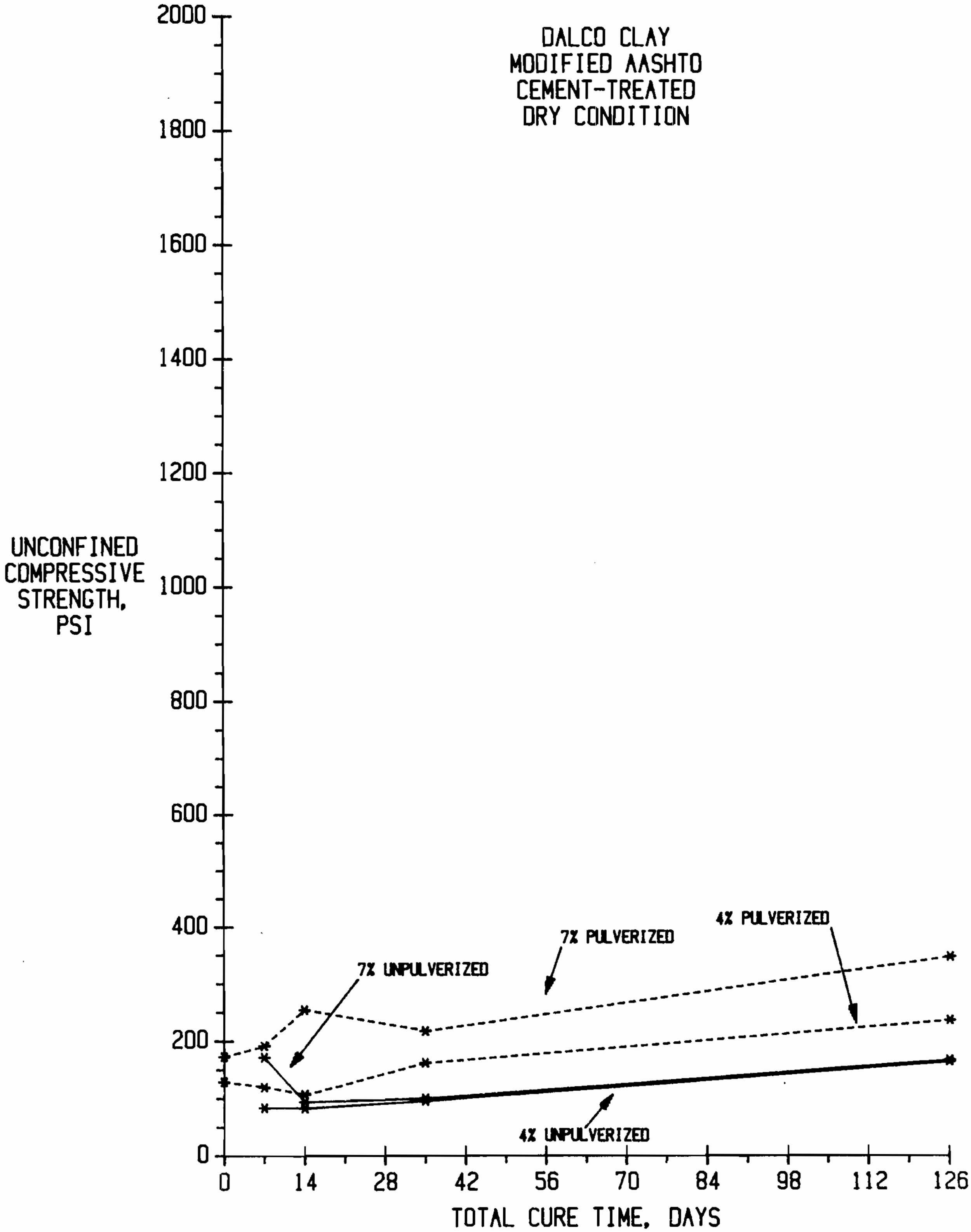


Fig 37. Effects of pulverization on dry unconfined compressive strengths of 4 and 7 percent cement-treated Dalco clay - modified AASHTO.

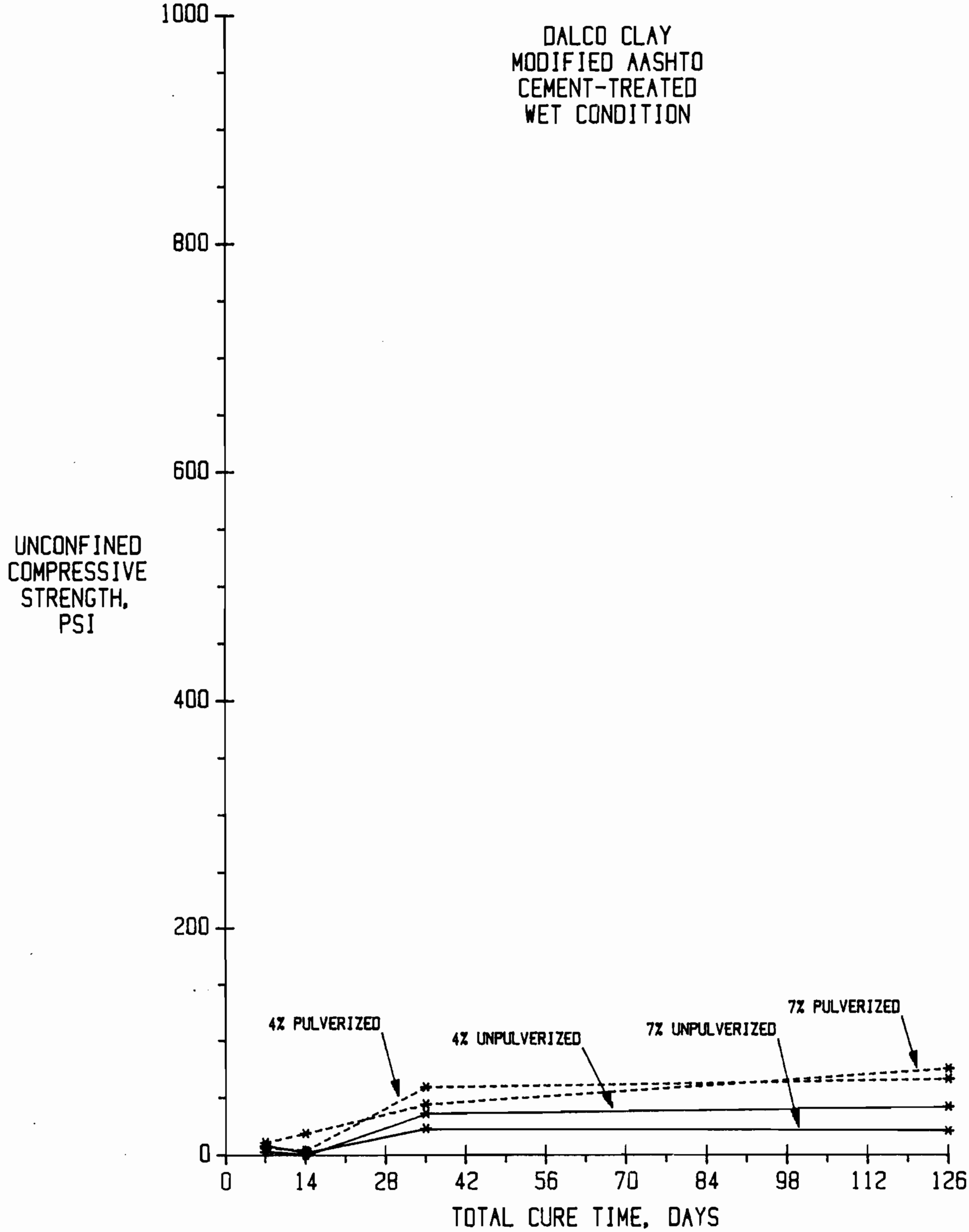


Fig 38. Effects of pulverization on wet unconfined compressive strengths of 4 and 7 percent cement-treated Dalco clay - modified AASHTO.

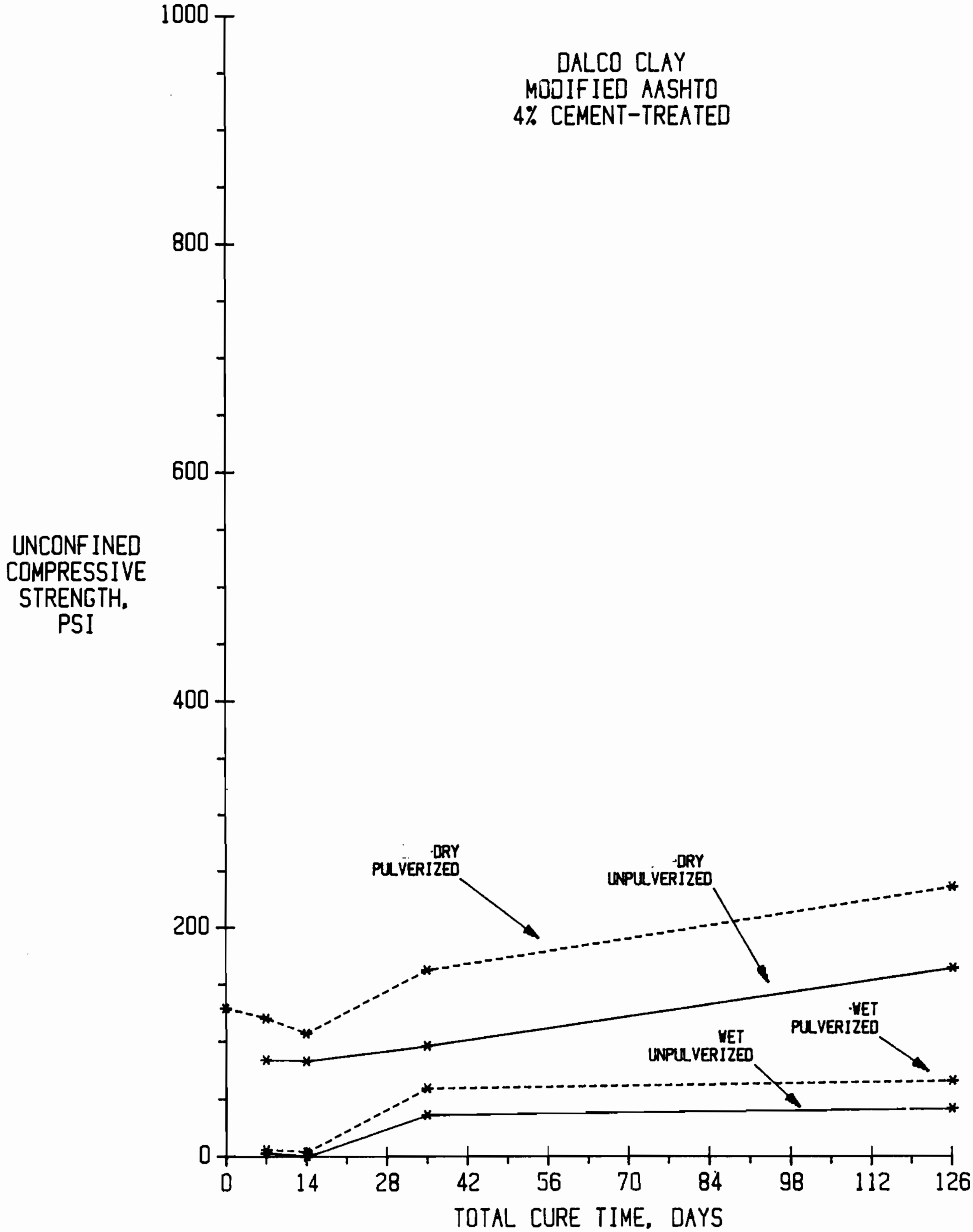


Fig 39. Effects of pulverization on dry and wet unconfined compressive strengths of 4 percent cement-treated Dalco clay - modified AASHTO.

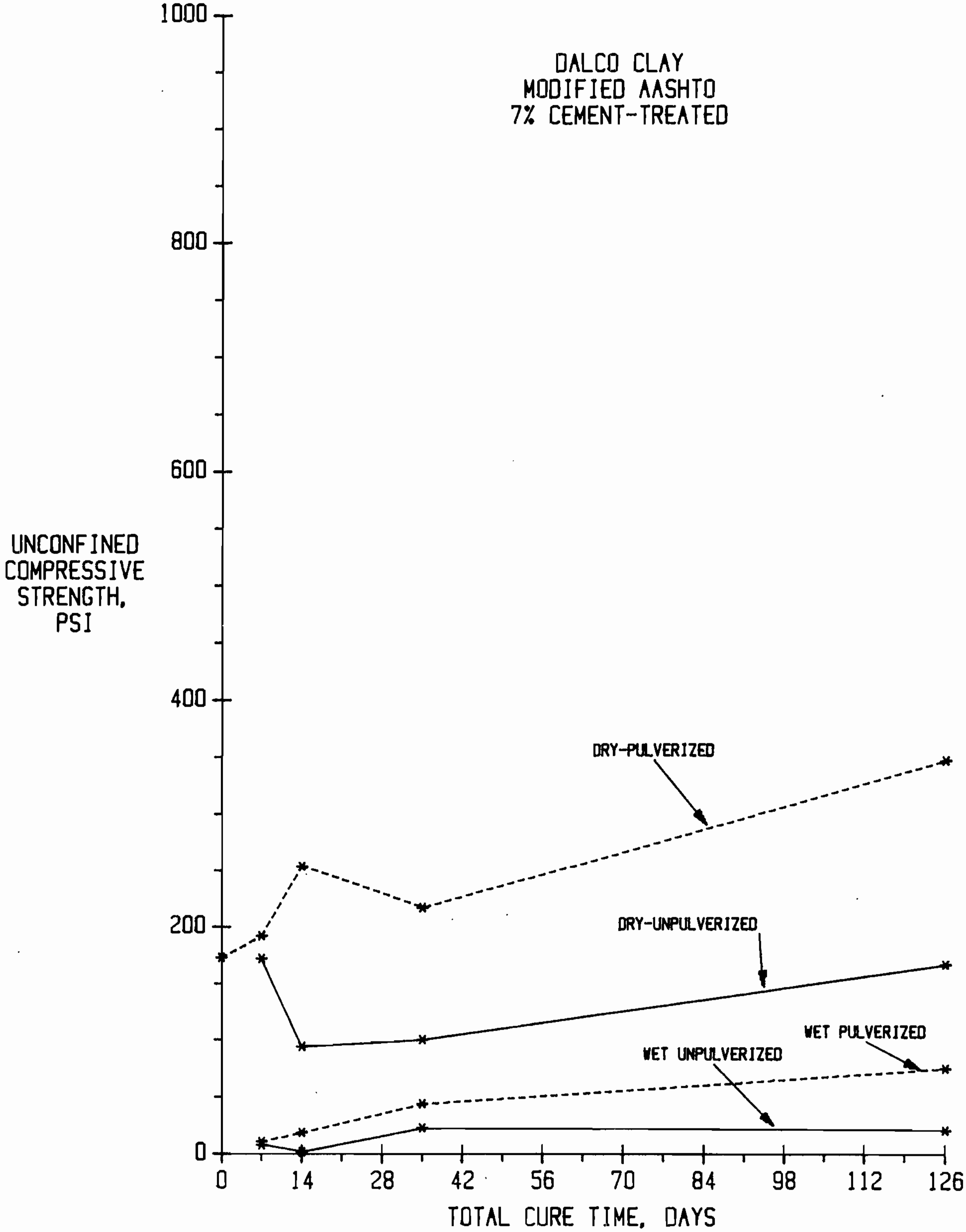


Fig 40. Effects of pulverization on dry and wet unconfined compressive strengths of 7 percent cement-treated Dalco clay - modified AASHTO.

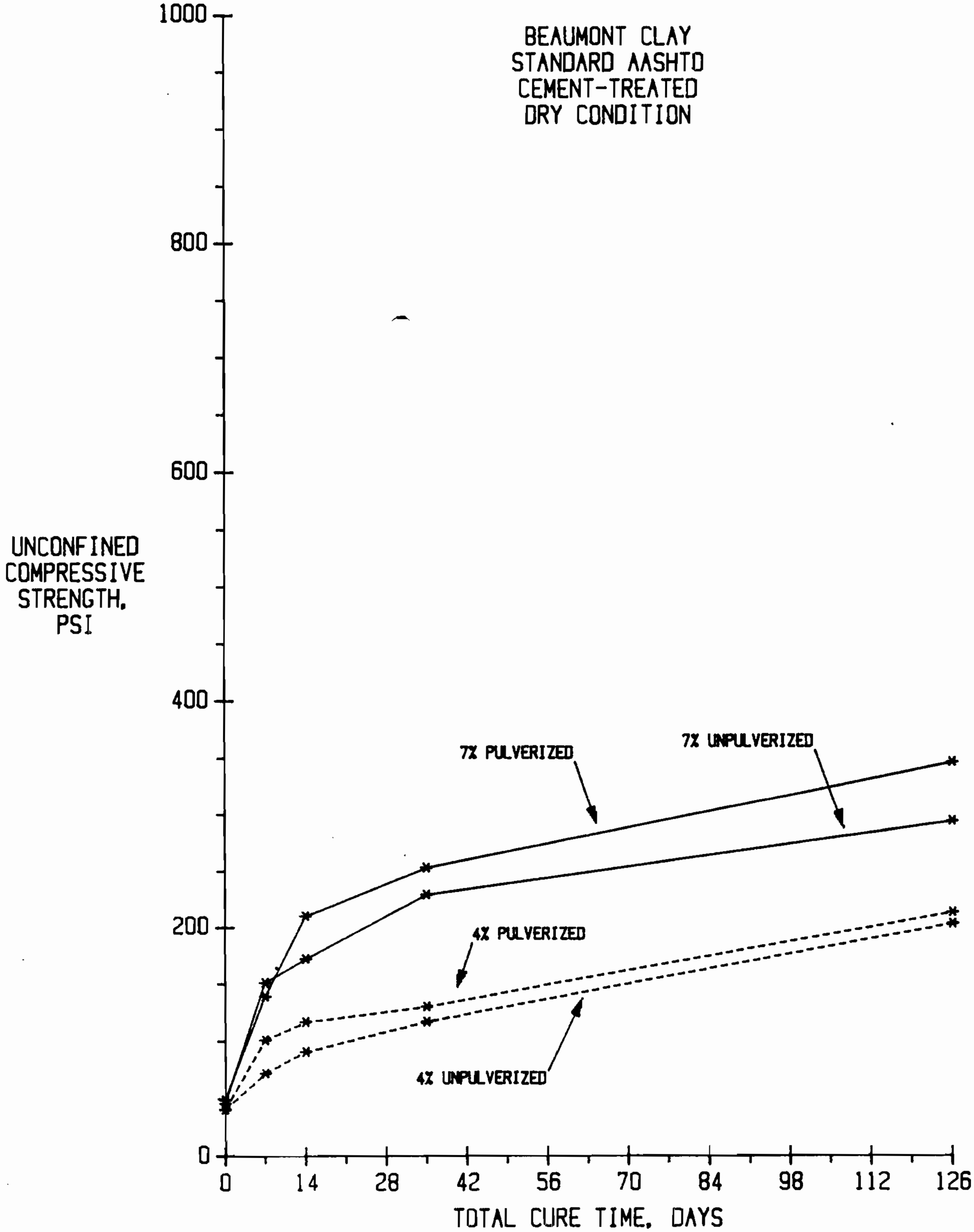


Fig 41. Effects of pulverization on dry unconfined compressive strength of 4 and 7 percent cement-treated Beaumont clay - standard AASHTO.

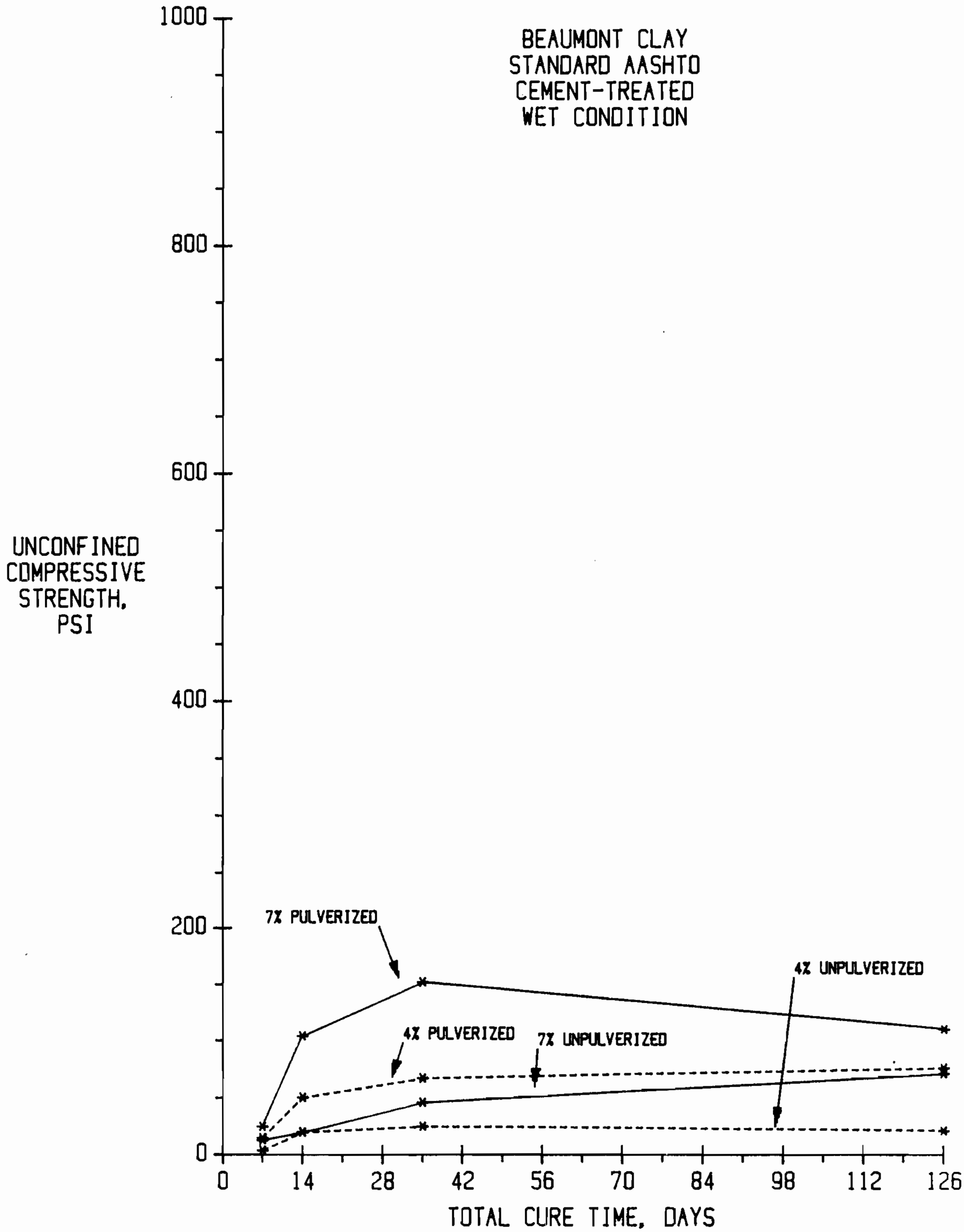


Fig 42. Effects of pulverization on wet unconfined compressive strength of 4 and 7 percent cement-treated Beaumont clay - standard AASHTO.

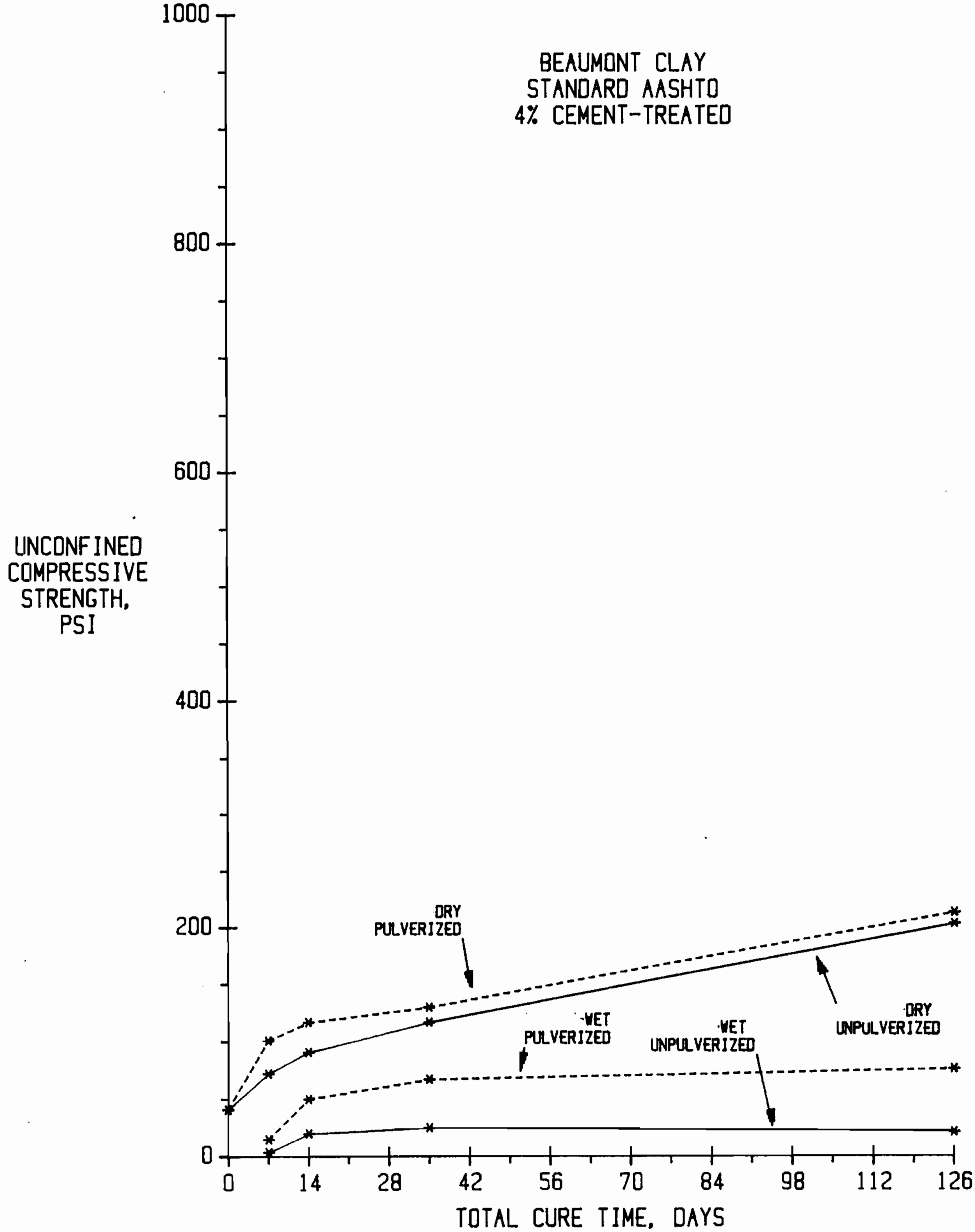


Fig 43. Effects of pulverization on dry and wet unconfined compressive strengths of 4 percent cement-treated Beaumont clay - standard AASHTO.

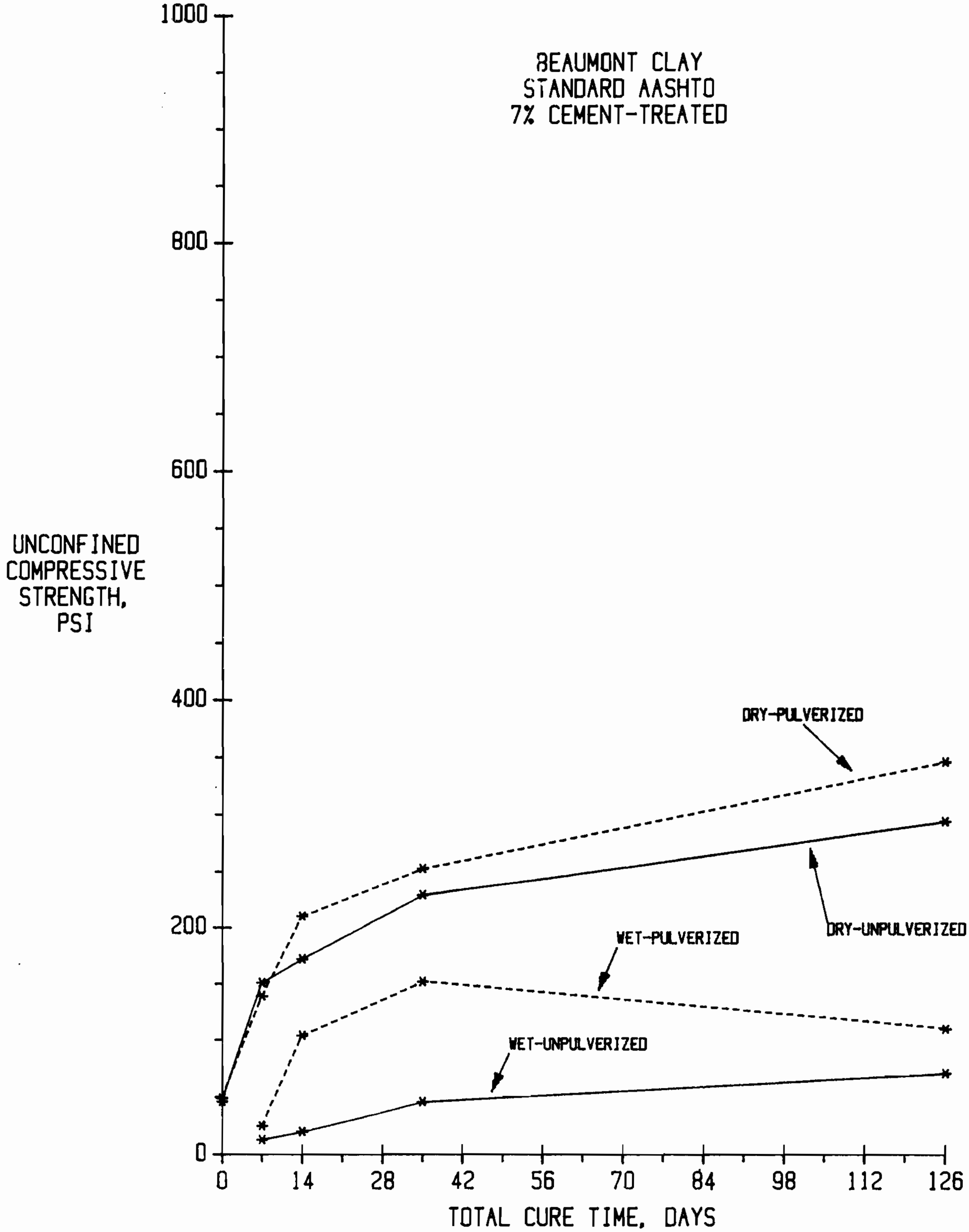


Fig 44. Effects of pulverization on dry and wet unconfined compressive strengths of 7 percent cement-treated Beaumont clay - standard AASHTO.

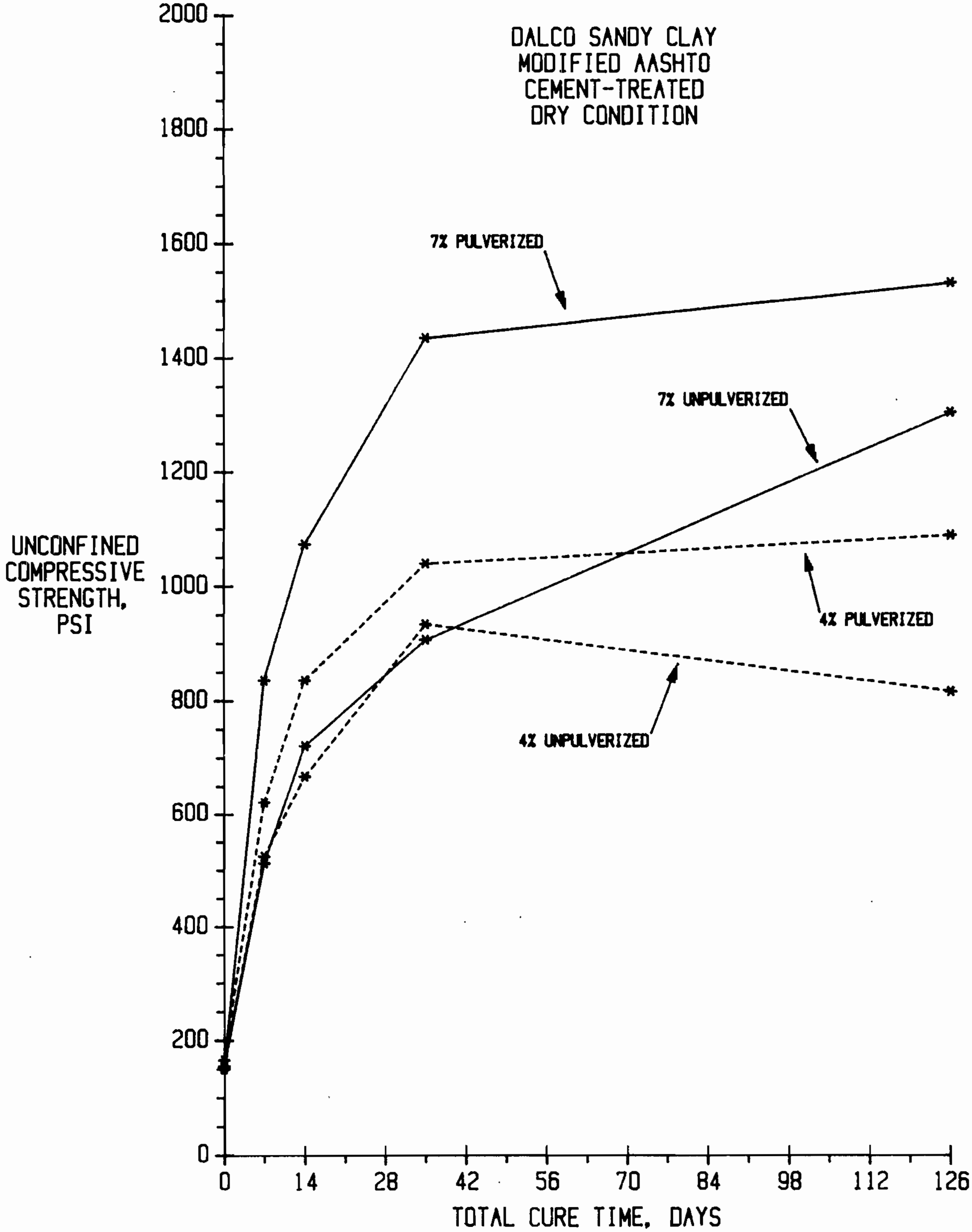


Fig 45. Effects of pulverization on dry unconfined compressive strengths of 4 and 7 percent cement-treated Dalco sandy clay - modified AASHTO.

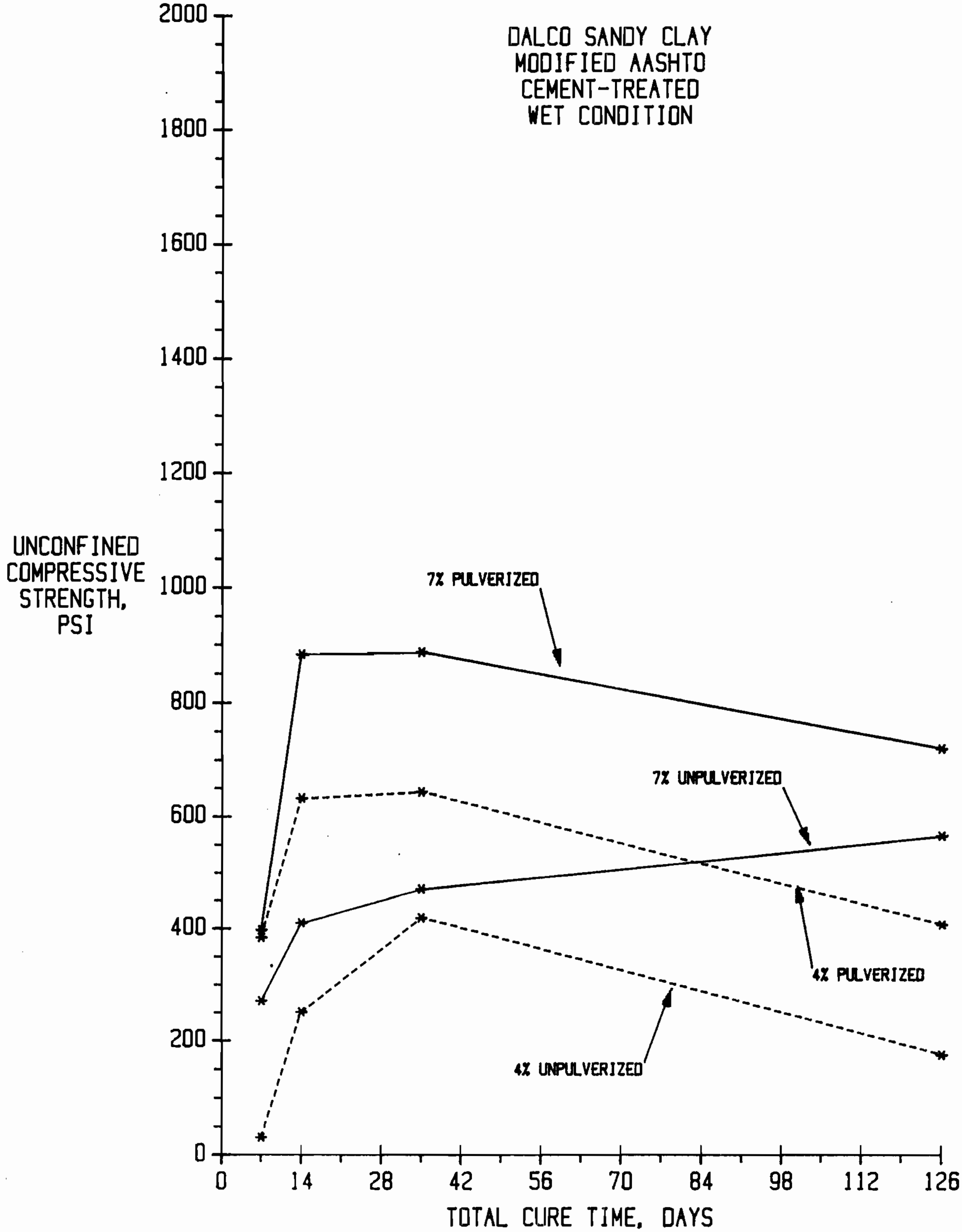


Fig 46. Effects of pulverization on wet unconfined compressive strength of 7 percent cement-treated Dalco sandy clay - modified AASHTO.

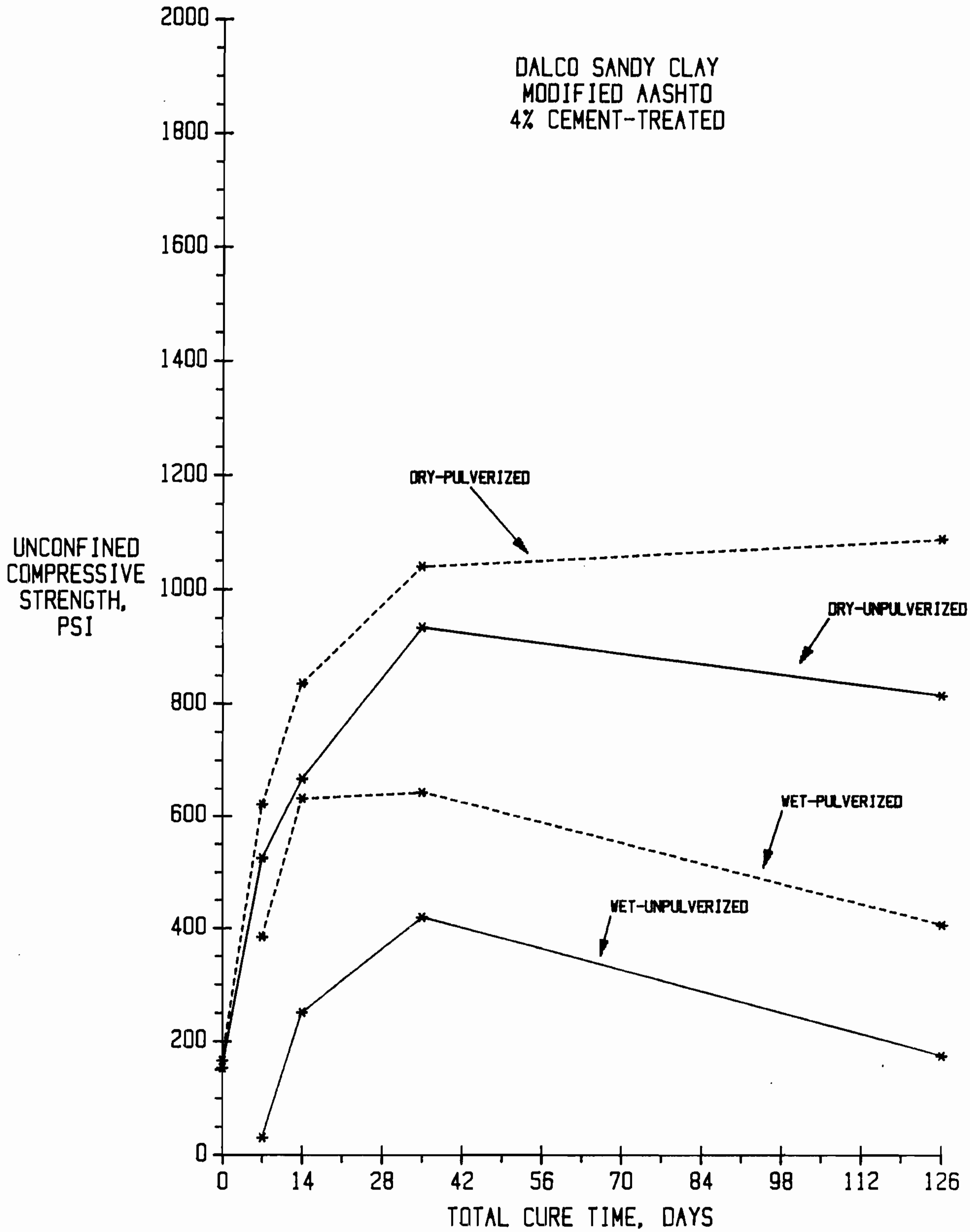


Fig 47. Effects of pulverization on dry and wet unconfined compressive strengths of 4 percent cement-treated Dalco sandy clay - modified AASHTO.

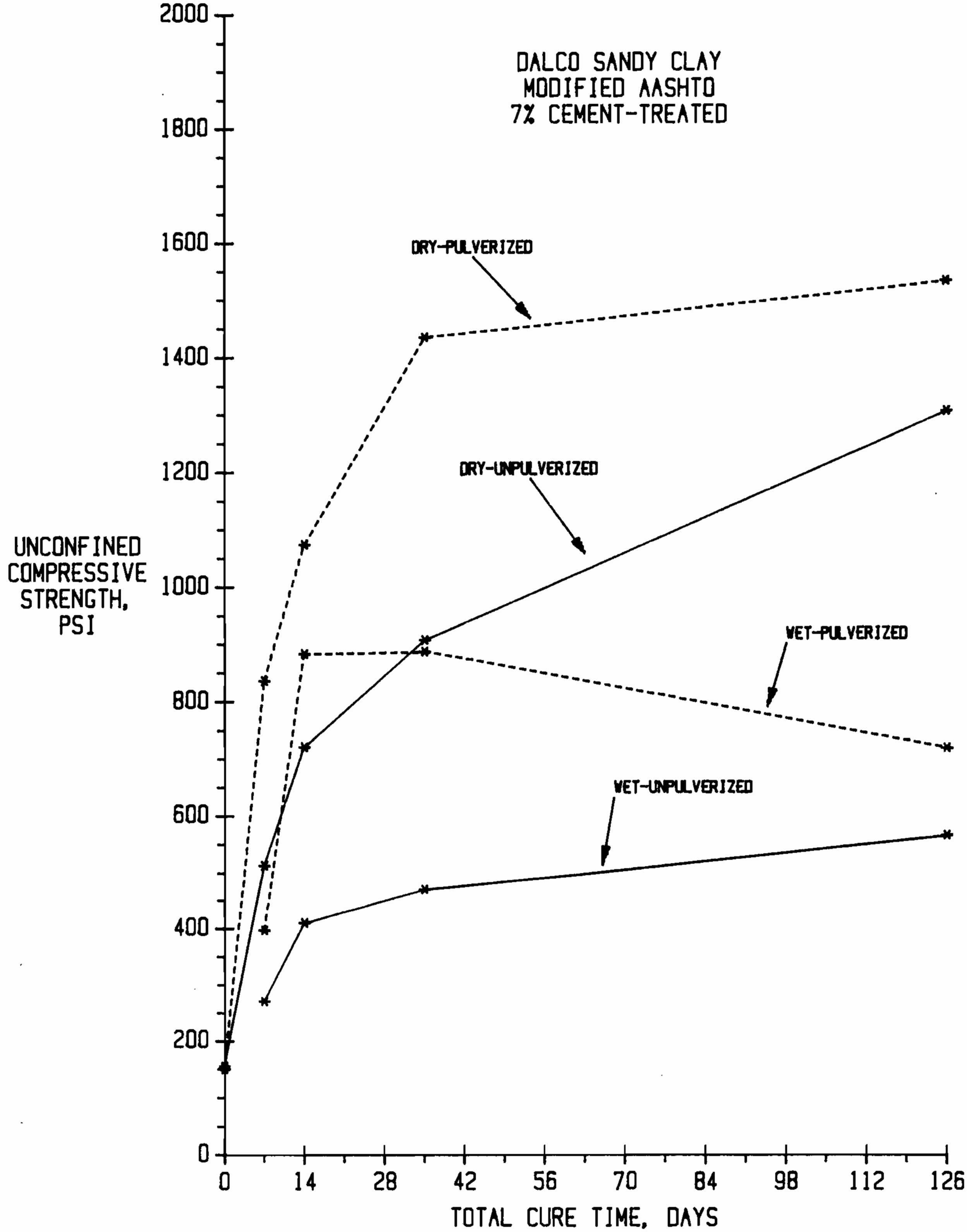


Fig 48. Effects of pulverization on dry and wet unconfined compressive strengths of 7 percent cement-treated Dalco sandy clay - modified AASHTO.

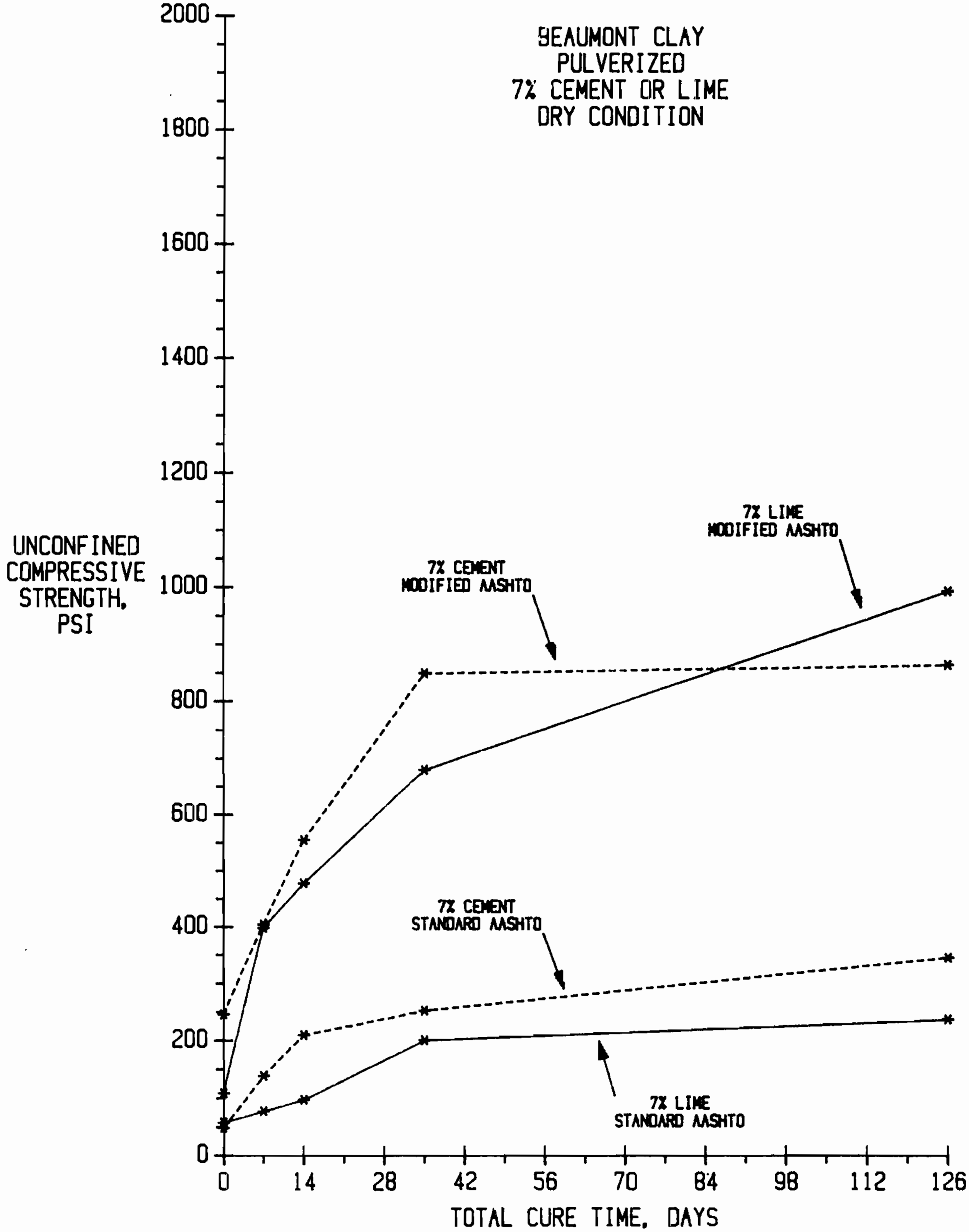


Fig 49. Dry unconfined compressive strength for pulverized Beaumont clay treated with 7 percent cement or lime - modified or standard AASHTO.

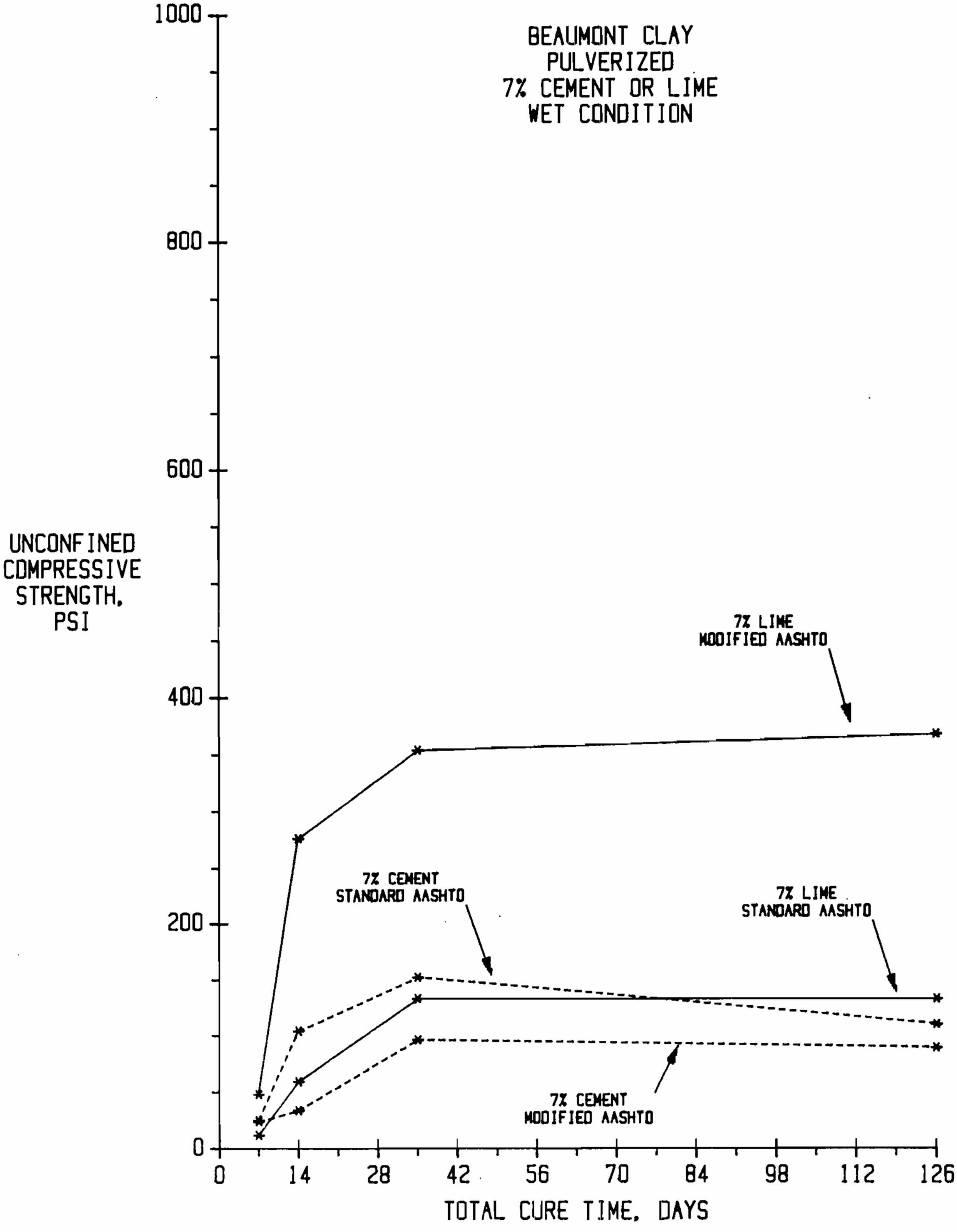


Fig 50. Wet unconfined compressive strength for pulverized Beaumont clay treated with 7 percent cement or lime - modified or standard AASHTO.

APPENDIX A

INDIVIDUAL TEST RESULTS

TABLE A1: SUMMARY OF TEST VALUES FOR DALCO CLAY, MODIFIED AASHTO, UNTREATED, PULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	59.3	25.4	94.3	26.5
		46.1		94.1	24.2
	Average:	52.7		94.2	25.4
7	Dry	48.9	29.1	91.7	25.1
		62.1		92.3	27.9
	Average:	55.5		92.0	26.5
7	Wet	2.0	29.1	92.6	44.3
		3.4		93.1	41.4
	Average:	2.7		92.9	42.9
14	Dry	32.0	28.4	90.8	27.7
		37.4		92.1	26.2
	Average:	34.7		91.5	27.0
14	Wet	2.9	28.4	92.3	40.0
		2.4		93.6	41.9
	Average:	2.7		93.0	41.0
35	Dry	45.2	30.0	90.3	27.4
		23.5		91.1	31.6
	Average:	34.4		90.7	29.5
35	Wet	3.7	30.0	90.2	37.1
		5.0		91.3	37.5
	Average:	4.4		90.8	37.3
126	Dry	39.8	25.9	93.9	26.1
		56.7		94.9	26.0
	Average:	48.3		94.4	26.1
126	Wet	0	25.9	93.9	26.1
		4.4		94.8	36.0
	Average:	2.2		94.2	36.0

TABLE A2: SUMMARY OF TEST VALUES FOR DALCO CLAY, MODIFIED AASHTO, 4% CEMENT-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	118.4	25.4	95.9	26.5
		139.0		95.6	24.2
	Average:	128.7		95.8	25.4
7	Dry	106.2	24.1	97.5	24.5
		134.1		97.7	25.1
	Average:	120.2		97.6	24.8
7	Wet	0	24.1	98.5	**
		5.5		98.2	34.5
	Average:	2.8		98.4	34.5
14	Dry	92.5	24.5	96.2	25.4
		120.8		96.9	25.0
	Average:	106.7		96.6	25.2
14	Wet	4.3	24.5	97.6	29.3
		3.9		97.3	33.8
	Average:	4.1		97.5	31.6
35	Dry	135.7	23.9	97.7	24.0
		187.4		97.1	22.8
	Average:	161.6		97.4	23.4
35	Wet	79.2	23.9	98.1	25.7
		39.0		97.5	27.6
	Average:	59.1		97.8	26.5
126	Dry	200.9	24.4	97.0	21.3
		271.8		96.1	21.7
	Average:	236.4		96.6	21.5
126	Wet	67.6	24.4	97.5	23.9
		63.9		96.7	24.8
	Average:	65.8		97.1	24.2

TABLE A3: SUMMARY OF TEST VALUES FOR DALCO CLAY, MODIFIED AASHTO, 7% CEMENT-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	165.1	21.3	99.8	20.1
		180.2	21.3	98.4	20.3
	Average:	172.7	21.3	99.1	20.2
7	Dry	162.7	21.3	99.9	20.1
		221.2		98.5	20.3
	Average:	192.0		99.2	20.2
7	Wet	12.2	21.3	100.2	28.9
		10.0		97.7	36.1
	Average:	11.1		99.0	32.5
14	Dry	239.5	21.7	99.6	19.6
		268.6		96.9	20.0
	Average:	254.1		98.3	19.8
14	Wet	15.5	21.7	98.8	27.5
		21.9		96.8	28.4
	Average:	18.7		97.8	28.0
35	Dry	200.9	20.5	101.3	19.4
		232.3		97.8	19.3
	Average:	216.6		99.6	19.3
35	Wet	56.1	20.5	100.9	18.1
		31.6		97.6	28.5
	Average:	43.9		99.0	26.7
126	Dry	324.3	20.7	100.9	18.1
		370.0		95.7	16.8
	Average:	347.2		98.3	17.4
126	Wet	103.5		98.2	24.2
		46.8	20.7	95.5	26.2
	Average:	75.2		96.9	25.2

TABLE A4: SUMMARY OF TEST VALUES FOR DALCO CLAY, MODIFIED AASHTO, 4% CEMENT-TREATED, UNPULVERIZED

Total Cure Time (Days)	Test Condi-tion	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
7	Dry	72.4	26.7	94.1	24.5
		95.5		94.5	27.8
	Average:	84.0		94.3	27.1
7	Wet	3.0	26.7	95.0	34.5
		3.6		95.6	31.6
	Average:	3.3		95.3	33.1
14	Dry	91.5	21.7	97.9	24.2
		75.2		98.5	22.3
	Average:	83.4		98.2	23.3
14	Wet	0	21.7	99.5	31.0
		0		99.2	31.4
	Average:	0		99.4	31.2
35	Dry	98.5	23.7	97.1	24.1
		92.5		97.6	20.6
	Average:	95.5		97.4	22.3
35	Wet	35.9	23.7	96.6	25.5
		0		96.3	25.7
	Average:	18.0		96.5	25.6
126	Dry	167.1	25.4	96.4	21.9
		161.1		97.1	21.6
	Average:	164.1		96.8	21.8
126	Wet	41.8	25.4	96.4	26.5
		0		95.0	28.1
	Average:	20.9		95.7	27.3

TABLE A5: SUMMARY OF TEST VALUES FOR DALCO CLAY, MODIFIED AASHTO, 7% CEMENT-TREATED, UNPULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
7	Dry	155.0	22.1	97.5	19.2
		189.0		95.3	19.4
	Average:	172.0		96.4	34.1
7	Wet	8.2	22.1	96.7	34.0
		8.0		96.0	34.2
	Average:	8.1		96.4	34.1
14	Dry	71.6	22.9	98.9	23.1
		115.4		95.0	17.0
	Average:	94.0		97.0	20.1
14	Wet	3.1	22.9	97.1	28.5
		0		94.6	33.4
	Average:	1.6		95.9	31.0
35	Dry	122.5	21.4	100.7	20.0
		77.2		96.7	17.4
	Average:	99.9		98.7	18.7
35	Wet	9.6	21.4	99.7	25.4
		36.8		97.3	23.9
	Average:	23.2		98.5	24.7
126	Dry	206.9	21.8	99.8	18.4
		127.3		97.8	17.1
	Average:	167.1		98.8	17.8
126	Wet	21.5	21.8	99.9	27.1
		19.9		97.4	24.2
	Average:	20.7		98.7	25.7

TABLE A6: SUMMARY OF TEST VALUES FOR DALCO CLAY, MODIFIED AASHTO, 4% LIME-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condi-tion	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	157.3	31.1	88.2	31.1
		182.6		88.2	29.4
	Average:	170.0		88.2	30.2
7	Dry	304.4	29.8	90.0	31.0
		292.5		89.5	28.3
	Average:	298.5		89.8	29.7
7	Wet	226.4	29.8	89.1	29.4
		242.0		88.8	29.3
	Average:	234.2		89.0	29.4
14	Dry	292.5	27.4	90.8	29.6
		296.4		90.4	31.6
	Average:	294.5		90.6	30.6
14	Wet	271.0	27.4	91.6	28.9
		258.6		91.3	**
	Average:	264.8		91.5	28.9
35	Dry	376.8	31.2	88.6	28.5
		370.8		88.3	28.6
	Average:	373.8		88.5	28.6
35	Wet	345.0	31.2	88.9	29.7
		347.8		88.7	30.2
	Average:	346.4		88.8	30.0
126	Dry	417.8	29.8	89.3	27.4
		467.5		89.5	26.2
	Average:	442.7		89.4	26.8
126	Wet	302.4	29.8	90.0	29.7
		268.6		89.9	29.8
	Average:	285.5		90.0	29.8

TABLE A7: SUMMARY OF TEST VALUES FOR DALCO CLAY, MODIFIED AASHTO, 7% LIME-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condi-tion	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	142.0	28.1	90.8	29.6
		136.5	28.1	90.0	29.7
	Average:	139.3	28.1	90.4	29.7
7	Dry	273.7	28.1	90.9	29.6
		277.7		91.1	29.7
	Average:	275.7		91.0	29.7
7	Wet	223.6	28.1	90.3	29.2
		218.4		90.6	29.8
	Average:	221.0		90.5	29.5
14	Dry	290.1	29.8	88.3	28.9
		315.9		88.4	28.4
	Average:	303.0		88.4	28.7
14	Wet	282.5	29.8	89.3	30.3
		278.1		89.2	27.8
	Average:	280.7		89.3	29.1
35	Dry	432.9	29.5	89.0	29.1
		440.1		89.0	28.5
	Average:	436.5		89.0	28.8
35	Wet	407.4	29.5	89.5	29.5
		380.4		89.2	27.1
	Average:	393.9		89.4	28.3
126	Dry	716.2	29.4	88.7	26.6
		775.9		89.3	27.2
	Average:	746.1		89.0	26.9
126	Wet	626.7	29.4	89.8	28.7
		596.8		89.9	27.2
	Average:	611.8		89.9	27.9

TABLE A8: SUMMARY OF TEST VALUES FOR BEAUMONT CLAY, STANDARD AASHTO, UNTREATED, PULVERIZED

Total Cure Time (Days)	Test Condi- tion	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	47.3	21.3	97.5	21.1
		47.0	28.1	97.2	21.4
	Average:	47.2	28.1	97.4	21.3
7	Dry	53.7	20.2	98.1	21.6
		49.6		95.8	19.4
	Average:	51.2		97.0	20.5
7	Wet	0.6	20.2	100.1	32.2
		0.5		92.8	33.5
	Average:	0.6		97.0	32.9
14	Dry	39.4	21.1	92.2	18.7
		43.8		93.1	18.9
	Average:	41.6		92.7	18.8
14	Wet	0	21.1	93.8	0
		0		88.1	0
	Average:	0		91.0	0
35	Dry	46.4	21.1	93.9	20.4
		50.1		93.3	19.7
	Average:	48.4		93.6	20.0
35	Wet	0	21.1	96.2	**
		0		92.6	**
	Average:	0		94.4	**
126	Dry	62.2	21.4	94.0	18.6
		74.8		94.5	18.8
	Average:	68.5		94.3	18.7
126	Wet	2.0	21.4	94.2	**
		0.6		93.6	34.2
	Average:	1.3		93.9	34.2

TABLE A9: SUMMARY OF TEST VALUES FOR BEAUMONT CLAY, STANDARD AASHTO, 4% CEMENT-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	40.6	25.4	92.9	25.5
		41.8	28.1	90.7	25.3
	Average:	41.2	28.1	91.8	25.4
7	Dry	103.6	23.5	93.4	25.1
		97.5		93.1	24.7
	Average:	100.6		93.3	24.9
7	Wet	15.9	23.5	90.4	31.5
		13.5		90.0	33.2
	Average:	14.7		90.2	32.3
14	Dry	107.4	23.3	92.1	24.0
		126.1		90.1	24.6
	Average:	116.8		91.1	24.3
14	Wet	44.8	23.3	92.1	24.0
		56.1		90.1	27.4
	Average:	50.5		90.6	27.2
35	Dry	138.5	25.1	93.8	24.5
		121.4		88.1	23.0
	Average:	130.0		92.0	23.7
35	Wet	61.3	25.1	90.7	28.4
		72.0		88.8	30.0
	Average:	66.7		89.8	29.2
126	Dry	198.9	24.8	92.5	22.5
		226.0		90.1	22.7
	Average:	212.5		91.3	22.6
126	Wet	71.6	24.8	92.5	28.3
		79.3		89.8	27.5
	Average:	75.5		91.2	27.9

TABLE A10: SUMMARY OF TEST VALUES FOR BEAUMONT CLAY, STANDARD AASHTO, 7% CEMENT-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	47.0	23.9	96.3	24.1
		51.3	28.1	95.7	23.8
	Average:	49.2	28.1	96.0	23.9
7	Dry	158.4	24.3	90.5	23.8
		119.4		88.8	23.5
	Average:	138.9		89.7	23.6
7	Wet	25.1	24.3	89.6	34.8
		24.7		88.8	31.7
	Average:	24.9		89.2	33.3
14	Dry	200.9	23.9	90.0	22.4
		219.6		87.7	22.8
	Average:	210.3		88.9	22.6
14	Wet	97.5	23.9	92.6	26.4
		109.8		85.9	27.4
	Average:	103.7		89.2	26.9
35	Dry	283.7	24.8	91.7	22.0
		222.0		89.7	21.6
	Average:	252.9		90.7	21.8
35	Wet	186.2	24.8	96.7	25.3
		117.0		87.6	26.0
	Average:	151.6		92.2	25.7
126	Dry	326.3	24.8	94.2	21.0
		366.1		90.7	19.3
	Average:	346.2		92.5	20.2
126	Wet	130.5	24.8	92.6	25.1
		88.5		87.0	26.1
	Average:	109.5		89.8	26.1

TABLE A11: SUMMARY OF TEST VALUES FOR BEAUMONT CLAY, STANDARD AASHTO, 4% CEMENT-TREATED, UNPULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	37.8	26.8	94.1	27.8
		43.4		92.6	25.8
	Average:	40.6		93.4	26.8
7	Dry	68.0	27.5	88.8	25.9
		76.0		88.2	26.6
	Average:	72.0		88.5	26.3
7	Wet	4.2	27.5	84.5	33.9
		4.8		87.5	35.5
	Average:	4.5		86.0	34.7
14	Dry	96.9	26.5	94.9	21.9
		85.5		92.3	23.5
	Average:	91.2		93.6	22.7
14	Wet	17.6	26.5	93.8	28.6
		23.1		88.3	28.1
	Average:	20.4		91.1	28.4
35	Dry	110.6	28.3	91.9	22.4
		122.9		86.8	22.8
	Average:	116.8		89.3	22.6
35	Wet	27.6	28.3	89.9	28.4
		22.5		87.0	27.2
	Average:	25.1		88.5	27.8
126	Dry	194.2	27.4	93.8	22.5
		211.7		91.3	23.0
	Average:	203.0		92.6	22.8
126	Wet	19.1	27.4	93.3	27.5
		22.3		90.1	29.1
	Average:	20.7		91.7	28.3

TABLE A12: SUMMARY OF TEST VALUES FOR BEAUMONT CLAY, STANDARD AASHTO, 7% CEMENT-TREATED, UNPULVERIZED

Total Cure Time (Days)	Test Condi-tion	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	48.5	25.0	95.4	24.5
		42.2		94.9	25.6
	Average:	45.8		95.2	25.0
7	Dry	141.6	27.4	93.1	23.1
		159.6		91.2	25.1
	Average:	150.6		92.2	24.6
7	Wet	15.8	27.4	93.1	33.5
		9.5		89.5	34.5
	Average:	12.7		91.3	34.0
14	Dry	194.9	25.9	95.4	22.5
		148.4		91.8	20.5
	Average:	171.7		93.6	21.5
14	Wet	9.3	25.9	94.3	28.3
		29.6		92.4	28.0
	Average:	19.5		93.3	28.2
35	Dry	265.8	26.2	95.3	20.9
		193.0		88.1	21.5
	Average:	229.4		91.7	21.2
35	Wet	35.8	26.2	93.5	27.3
		56.9		88.7	27.8
	Average:	46.4		91.1	27.6
126	Dry	294.4	26.8	95.6	20.5
		294.4		93.1	20.0
	Average:	294.4		94.4	20.3
126	Wet	36.3	26.8	94.5	25.1
		105.0		92.5	26.5
	Average:	70.7		92.5	25.8

TABLE A13: SUMMARY OF TEST VALUES FOR BEAUMONT CLAY, STANDARD AASHTO, 4% LIME-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condi- tion	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	53.7	18.6	90.2	18.5
		51.7		89.7	18.7
	Average:	52.7		90.0	18.6
7	Dry	74.4	18.7	90.4	19.9
		65.6		91.3	18.6
	Average:	70.0		90.9	19.3
7	Wet	8.0	18.7	90.3	31.2
		5.6		89.3	34.1
	Average:	6.8		89.8	32.7
14	Dry	86.5	20.1	86.5	19.8
		68.0		86.0	18.8
	Average:	77.3		86.3	19.3
14	Wet	40.0	20.1	86.6	28.8
		32.0		87.3	22.3
	Average:	36.0		87.0	25.6
35	Dry	113.8	19.9	87.9	19.1
		93.1		87.4	19.3
	Average:	103.5		87.7	19.2
35	Wet	52.5	19.9	88.6	27.3
		63.7		87.9	28.2
	Average:	58.1		88.3	27.8
126	Dry	119.4	20.1	88.1	21.0
		125.3		87.8	18.3
	Average:	122.3		88.0	19.7
126	Wet	**	20.1	88.6	29.9
		57.7		88.2	28.3
	Average:	57.7		88.2	28.3

TABLE A14: SUMMARY OF TEST VALUES FOR BEAUMONT CLAY, STANDARD AASHTO, 7% LIME-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	55.3	19.3	89.6	19.1
		61.7		90.6	19.5
	Average:	58.5		90.1	19.3
7	Dry	81.2	20.8	87.3	19.8
		73.8		87.0	20.2
	Average:	77.5		87.2	20.0
7	Wet	12.3	20.8	86.7	34.4
		11.0		86.5	34.5
	Average:	11.7		86.6	34.4
14	Dry	105.4	18.9	89.2	20.8
		90.1		89.2	19.6
	Average:	97.8		89.2	20.2
14	Wet	59.7	18.9	88.7	27.6
		59.1		89.6	26.6
	Average:	59.4		89.2	27.1
35	Dry	195.0	20.8	89.1	19.3
		206.9		89.8	20.2
	Average:	201.0		89.5	19.8
35	Wet	127.3	20.8	88.5	29.6
		139.3		88.8	29.7
	Average:	133.3		88.7	29.7
126	Dry	252.7	20.8	87.0	18.3
		222.8		86.3	16.7
	Average:	237.8		86.7	17.5
126	Wet	145.2	20.8	87.5	30.3
		121.4		87.7	32.0
	Average:	133.3		87.6	31.2

TABLE A15: SUMMARY OF TEST VALUES FOR BEAUMONT CLAY, MODIFIED AASHTO, UNTREATED, PULVERIZED

Total Cure Time (Days)	Test Condi-tion	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	143.6	17.8	110.4	17.6
		145.2		112.0	17.9
	Average:	144.4		111.2	17.8
7	Dry	206.9	16.4	113.2	16.4
		208.9		112.3	16.0
	Average:	207.9		112.8	16.2
7	Wet	0	16.4	113.3	0
		0		112.2	0
	Average:	0		112.8	0
14	Dry	258.6	16.4	113.3	15.8
		242.7		112.9	15.9
	Average:	250.7		113.1	15.9
14	Wet	0	16.4	111.3	0
		0		112.2	0
	Average:	0		111.8	0
35	Dry	292.4	16.1	112.2	15.3
		346.2		112.8	14.8
	Average:	319.3		112.5	15.1
35	Wet	0	16.1	113.9	0
		0		113.0	0
	Average:	0		113.5	0
126	Dry	672.4	16.5	111.8	10.9
		775.9		112.3	11.4
	Average:	724.1		112.1	11.2
126	Wet	0	16.5	113.1	0
		0		113.2	0
	Average:	0		113.2	0

TABLE A16: SUMMARY OF TEST VALUES FOR BEAUMONT CLAY, MODIFIED AASHTO, 7% CEMENT-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	257.4	14.6	110.8	14.5
		234.8		109.8	14.7
	Average:	246.1		110.3	14.6
7	Dry	386.0	15.8	111.6	13.9
		421.8		110.2	14.4
	Average:	403.9		110.9	14.2
7	Wet	24.7	15.8	111.4	28.9
		23.5		108.6	29.2
	Average:	24.1		110.0	29.1
14	Dry	459.6	15.7	110.8	13.7
		650.5		109.6	13.6
	Average:	555.1		110.2	13.7
14	Wet	24.3	15.7	108.9	24.1
		43.8		109.6	20.6
	Average:	34.1		109.3	23.3
35	Dry	706.3	15.7	111.6	11.8
		994.7		110.4	12.9
	Average:	850.5		111.0	12.3
35	Wet	93.5	15.7	111.6	11.8
		97.5		108.4	22.9
	Average:	95.5		109.3	21.8
126	Dry	951.0	15.1	112.5	11.3
		779.9		109.9	11.4
	Average:	865.5		111.2	11.4
126	Wet	73.2	15.1	109.0	19.2
		101.9		107.8	19.4
	Average:	0		113.2	0

TABLE A17: SUMMARY OF TEST VALUES FOR BEAUMONT CLAY, MODIFIED AASHTO, 7% LIME-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	111.4	18.7	99.7	18.6
		107.4		100.2	18.7
	Average:	109.4		100.0	18.7
7	Dry	397.9	17.7	104.2	17.4
		397.9		104.2	17.1
	Average:	397.9		104.2	17.3
7	Wet	52.8	17.7	103.1	26.7
		42.8		103.1	26.0
	Average:	47.8		103.1	26.4
14	Dry	437.7	17.7	103.4	16.9
		517.3		103.8	16.7
	Average:	477.5		103.6	16.8
14	Wet	294.4	17.7	102.9	22.5
		258.6		103.2	21.9
	Average:	276.5		103.1	22.2
35	Dry	686.4	17.7	103.7	16.3
		676.4		104.1	15.7
	Average:	681.4		103.5	22.0
35	Wet	364.1	17.7	103.4	21.8
		344.2		103.5	22.1
	Average:	354.2		103.5	22.0
126	Dry	915.1	17.4	104.2	13.9
		1074.3		103.4	13.9
	Average:	994.7		103.8	13.9
126	Wet	328.3	17.4	104.2	21.5
		407.8		104.3	21.2
	Average:	368.1		104.3	21.4

TABLE A18: SUMMARY OF TEST VALUES FOR DALCO SANDY CLAY, MODIFIED AASHTO, UNTREATED, PULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	71.6	10.9	121.2	10.5
		58.1		120.8	11.2
	Average:	64.8		121.0	10.9
7	Dry	200.5	10.1	121.7	8.9
		209.3		123.0	9.1
	Average:	204.9		122.4	9.0
7	Wet	4.9	10.1	121.7	18.6
		7.0		122.7	17.6
	Average:	6.0		122.2	18.1
14	Dry	179.0	10.4	123.9	9.2
		198.1		124.5	9.3
	Average:	188.6		124.2	9.3
14	Wet	14.2	10.4	123.2	13.8
		18.5		123.4	13.9
	Average:	16.4		123.3	13.9
35	Dry	230.8	10.4	123.6	8.5
		255.0		124.7	8.3
	Average:	242.9		124.2	8.4
35	Wet	23.9	10.4	123.4	13.9
		21.9		124.2	13.3
	Average:	22.9		123.8	13.6
126	Dry	706.3	9.7	124.1	5.1
		756.0		124.4	4.8
	Average:	731.2		124.3	5.0
126	Wet	8.5	9.7	125.7	14.2
		15.9		125.1	14.5
	Average:	12.2		125.4	14.4

TABLE A19: SUMMARY OF TEST VALUES FOR DALCO SANDY CLAY, MODIFIED AASHTO, 4% CEMENT-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	171.5	9.8	123.2	9.3
		161.5		123.3	10.3
	Average:	166.5		123.3	9.8
7	Dry	732.1	10.1	121.6	8.8
		509.3		119.7	8.9
	Average:	620.7		120.7	8.9
7	Wet	393.9	10.1	121.3	11.5
		374.0		118.8	12.4
	Average:	384.0		120.1	12.0
14	Dry	851.5	10.4	122.6	8.9
		819.6		120.2	9.2
	Average:	835.6		121.4	9.1
14	Wet	690.7	10.4	121.0	10.3
		573.0		119.4	12.9
	Average:	631.9		120.2	11.6
35	Dry	1155.9	10.4	122.2	8.2
		923.1		120.4	8.4
	Average:	1039.5		121.3	8.3
35	Wet	698.3	10.4	122.0	13.6
		586.9		120.1	11.2
	Average:	642.6		121.1	12.4
126	Dry	1209.6	10.5	121.3	5.8
		970.8		119.3	5.2
	Average:	1090.2		120.3	5.5
126	Wet	445.6	10.5	120.9	11.0
		366.1		119.1	12.8
	Average:	405.8		120.0	11.7

TABLE A20: SUMMARY OF TEST VALUES FOR DALCO SANDY CLAY, MODIFIED AASHTO, 7% CEMENT-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	166.3	10.7	123.1	10.5
		134.5		121.6	10.8
	Average:	150.4		122.4	10.7
7	Dry	923.1	10.8	119.7	9.1
		748.0		117.9	8.8
	Average:	835.6		118.8	9.0
7	Wet	532.2	10.8	119.7	11.4
		262.6		116.6	15.1
	Average:	397.4		118.2	13.3
14	Dry	1098.2	10.3	122.5	8.9
		1050.4		120.9	8.8
	Average:	1074.3		121.7	8.9
14	Wet	954.9	10.3	123.4	10.0
		811.7		119.5	9.8
	Average:	883.3		121.5	9.9
35	Dry	1527.9	10.4	122.6	9.1
		1342.9		120.2	8.4
	Average:	1435.2		121.4	8.8
35	Wet	915.1	10.4	122.2	11.2
		859.4		119.8	10.5
	Average:	887.3		121.0	10.9
126	Dry	1687.0	10.3	123.6	6.1
		376.7		118.6	6.0
	Average:	1531.8		121.1	6.1
126	Wet	783.8	10.3	121.9	7.9
		652.5		118.5	11.4
	Average:	718.2		120.2	9.7

TABLE A21: SUMMARY OF TEST VALUES FOR DALCO SANDY CLAY, MODIFIED AASHTO, 4% CEMENT-TREATED, UNPULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	152.8	11.9	118.6	11.9
7	Dry	588.9	11.3	121.1	9.0
		461.5		116.8	9.2
	Average:	525.2		119.0	9.1
7	Wet	36.6	11.3	118.8	14.8
		25.5		117.7	15.2
	Average:	31.0		118.3	15.0
14	Dry	748.0	11.5	120.6	9.2
		588.9		119.4	8.2
	Average:	668.5		120.0	8.7
14	Wet	302.4	11.5	120.9	12.4
		199.9		119.4	14.0
	Average:	251.2		120.2	13.2
35	Dry	830.8	10.9	121.5	8.6
		1037.7		121.3	8.2
	Average:	934.3		121.4	8.4
35	Wet	399.5	10.9	120.0	9.6
		437.7		119.9	9.3
	Average:	418.6		120.0	9.5
126	Dry	859.4	11.0	120.6	5.7
		771.9		118.4	5.3
	Average:	815.7		119.5	5.5
126	Wet	159.2	11.0	118.7	12.9
		191.0		115.7	13.4
	Average:	175.1		117.2	13.2

TABLE A22: SUMMARY OF TEST VALUES FOR DALCO SANDY CLAY, MODIFIED AASHTO, 7% CEMENT-TREATED, UNPULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	155.2	11.1	122.1	11.1
7	Dry	660.5	11.2	120.5	9.3
		366.1		118.9	9.0
	Average:	513.3		119.7	9.2
7	Wet	366.1	11.2	121.6	11.9
		175.1		117.5	12.7
	Average:	270.6		119.6	12.3
14	Dry	671.6	11.3	122.3	8.7
		770.3		119.9	8.2
	Average:	721.0		121.1	8.5
14	Wet	429.7	11.3	119.8	10.1
		390.0		117.7	11.3
	Average:	409.9		118.8	10.7
35	Dry	883.3	11.9	119.7	7.8
		931.0		119.0	8.8
	Average:	907.2		119.4	8.3
35	Wet	541.1	11.9	120.9	9.9
		397.9		119.0	10.5
	Average:	469.5		120.0	10.2
126	Dry	1273.2	11.9	120.7	6.6
		1336.9		120.1	6.9
	Average:	1305.1		120.4	6.8
126	Wet	573.0	11.9	119.4	9.3
		557.0		118.8	9.1
	Average:	565.0		119.1	9.2

TABLE A23: SUMMARY OF TEST VALUES FOR DALCO SANDY CLAY, MODIFIED AASHTO, 4% LIME-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condition	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	97.1	13.3	113.7	13.1
		91.5		114.8	13.4
	Average:	94.3		114.3	13.3
7	Dry	177.1	12.3	116.7	12.9
		191.0		116.6	11.3
	Average:	184.0		116.7	12.1
7	Wet	108.2	12.3	117.6	13.0
		117.4		117.5	13.3
	Average:	112.8		117.6	13.2
14	Dry	196.7	12.5	116.0	11.6
		224.1		116.9	11.3
	Average:	210.4		116.5	11.5
14	Wet	140.1	12.5	116.9	12.9
		140.1		115.8	12.8
	Average:	140.1		116.4	12.9
35	Dry	417.8	12.6	117.6	10.6
		318.3		118.4	10.3
	Average:	368.1		118.0	10.5
35	Wet	202.9	12.6	117.0	11.7
		222.8		117.5	11.5
	Average:	212.9		117.3	11.6
126	Dry	346.2	12.5	116.6	9.2
		397.9		117.3	7.3
	Average:	372.1		117.0	8.3
126	Wet	202.9	12.5	116.5	11.1
		228.8		117.4	12.1
	Average:	215.8		117.0	11.6

TABLE A24: SUMMARY OF TEST VALUES FOR DALCO SANDY CLAY, MODIFIED AASHTO, 7% LIME-TREATED, PULVERIZED

Total Cure Time (Days)	Test Condi-tion	Unconfined Compressive Strength, (psi)	At Compaction Water Content, (%)	At Compaction Dry Density, (pcf)	Test Water Content, (%)
0	Dry	97.9	12.5	111.4	12.5
		95.4		112.4	12.4
	Average:	96.7		111.9	12.5
7	Dry	185.4	12.1	114.1	11.3
		198.9		114.5	11.2
	Average:	192.2		114.3	11.3
7	Wet	94.5	12.1	115.0	13.5
		102.3		115.5	13.6
	Average:	98.4		115.3	13.6
14	Dry	222.8	12.4	114.3	11.5
		232.2		115.3	11.4
	Average:	227.5		114.8	11.5
14	Wet	133.1	12.4	115.2	13.0
		135.0		114.2	13.1
	Average:	134.1		114.7	13.1
35	Dry	330.2	12.6	115.5	10.2
		358.1		115.4	10.1
	Average:	344.1		115.5	10.2
35	Wet	189.0	12.6	116.5	11.8
		202.9		115.9	11.8
	Average:	196.0		116.2	11.8
126	Dry	485.4	13.0	114.3	8.0
		489.4		114.6	8.2
	Average:	487.4		114.5	8.1
126	Wet	262.6	13.0	115.4	11.9
		262.6		115.4	11.7
	Average:	262.6		115.4	11.8