



A Preliminary
Evaluation of Chem-crete
in
Oregon Asphalt Mixes

by
S. J. Pong
and
R.G. Hicks

Department of Civil Engineering
Oregon State University
Corvallis, OR 97331

September 1980

INTRODUCTION

Chem-Crete concentrate is a proprietary product that can be blended at the refinery. It is normally blended 1 part Chem-Crete concentrate to 9 parts of asphalt cement by weight to enhance the rheological properties of the asphalt cement. It is claimed that the compressive and tensile strengths, the stability and the durability will increase in asphalt-aggregate mixtures when it is used.

The Oregon State Highway Department provided 10 laboratory-prepared asphalt concrete specimens (2.5" x 4") to the Transportation Research Institute of Oregon State University for resilient modulus and fatigue testing. Five specimens were fabricated using asphalt cement, AR-4000W, and another five were fabricated using AR-4000W plus 10% Chem-Crete concentrate. The sample I.D. and its asphalt content are shown in Table 1.

TEST PROCEDURES

Before the resilient modulus test, the thickness and weights of each specimen were measured in order to calculate the bulk specific gravity and density. The summary of specimens' characteristics are shown in Table 1.

Resilient modulus tests were conducted using the diametral test method. The vertical cyclic-load was measured with a strainert load cell (1000 lbs capacity) under the tested specimen. Horizontal deformations were measured by two horizontal transducer strain gauges and recorded with an IIP recorder. All specimens were tested at an initial strain of 100 microstrain, a 0.1 sec. cyclic-load duration and a frequency of 1 Hz.

The resilient modulus for 4-inch diameter specimen was calculated using the following equation:

$$M_R = \frac{P}{t \cdot \Delta h} (0.9976 \nu + 0.2692) \quad - - - (1)$$

where: P = applied vertical cyclic-load (lbs)

t = thickness of the specimen (inch)

Δh = horizontal elastic deformation (inch)

ν = Poisson's ratio (ν is assumed to be 0.35 for asphalt concrete)

Fatigue testing was conducted after the diametral modulus test. Each specimen was tested at the cyclic-load used in modulus test which induced 100 microstrain in the specimen. During the fatigue test, the permanent vertical deformation was also measured with a dial gauge. Failure of the sample was determined by an approximately 6 mm (1/4 inch) wide vertical crack across the diameter of the specimen. The vertical crack breaks an electrical circuit going through the metallic strip, stopping the test and the counter at the exact number of repetitions at failure.

TEST RESULTS

The resilient modulus and the applied cyclic-load at an initial strain of 100 microstrain in the specimens are shown in Table 2 and plotted in Figure 1, as a function of asphalt content. The resilient modulus of specimens without Chem-Crete concentrate fall within the range from 3.12×10^5 psi to 5.87×10^5 psi. For the specimens blended Chem-Crete concentrate, the range is from 3.13×10^5 psi to 13.37×10^5 psi.

The curves for fatigue life vs. asphalt content are shown in Figure 2. For the specimens without Chem-Crete concentrate, the range of repetitions is from 20,000 to 366,000 times, and the optimum asphalt content is 6% at its maximum repetition. The range of repetition for the specimens blended Chem-Crete concentrate is from 62,000 to 900,000 times.

Permanent deformation results are shown in Figure 3 through 6. All the specimens blended with Chem-Crete concentrate exhibited lower vertical strain than the specimens without Chem-Crete concentrate. The deformation curves of these two mixtures are almost parallel to each other within the service range.

CONCLUSIONS

This testing indicated that the resilient modulus of asphalt mixture would increase when the Chem-Crete concentrate was used. The modulus is increased as the asphalt content is decreased. At 6.5% asphalt content, the resilient modulus of these two mixtures are about the same.

The fatigue life of specimens blended Chem-Crete concentrate is about two - four times that of the untreated specimens. The average fatigue life of the specimens blended with Chem-Crete concentrate is about three times as those without Chem-Crete concentrate.

Finally, the permanent deformation characteristics of specimens treated with Chem-Crete are considerably better than those of the untreated specimens.

Table 1. Summary of Characteristics of Specimens

Sample I.D.	A/C		Avg. Thickness (inch)	Dry wt. (gm)	Bulk Sp. Gravity	Density (pcf)
	AR-4000	Chem-Crete				
15	4.5%	0	2.425	1146.24	2.3117	143.00
11	5.0%	0	2.431	1149.78	2.3315	143.08
12	5.5%	0	2.425	1154.94	2.3474	144.08
13	6.0%	0	2.368	1157.77	2.4071	147.90
14	6.5%	0	2.383	1161.86	2.4028	147.49
20	4.5%	10%	2.441	1144.16	2.3154	143.56
16	5.0%	10%	2.386	1149.09	2.3659	145.69
17	5.5%	10%	2.380	1156.76	2.3899	147.03
18	6.0%	10%	2.397	1158.23	2.3799	146.18
19	6.5%	10%	2.364	1159.02	2.4157	148.32

Table 2. Summary of Applied Load and Resilient Modulus

Sample I.D.	Applied Cyclic-load (lbs) at 100 μ strain	Resilient Modulus $\times 10^5$ (psi)
Untreated		
11	403	5.27
12	404	5.26
13	263	3.53
14	233	3.12
15	446	5.87
Treated		
16	792	10.56
17	628	8.43
18	372	4.96
19	230	3.13
20	1017	13.37

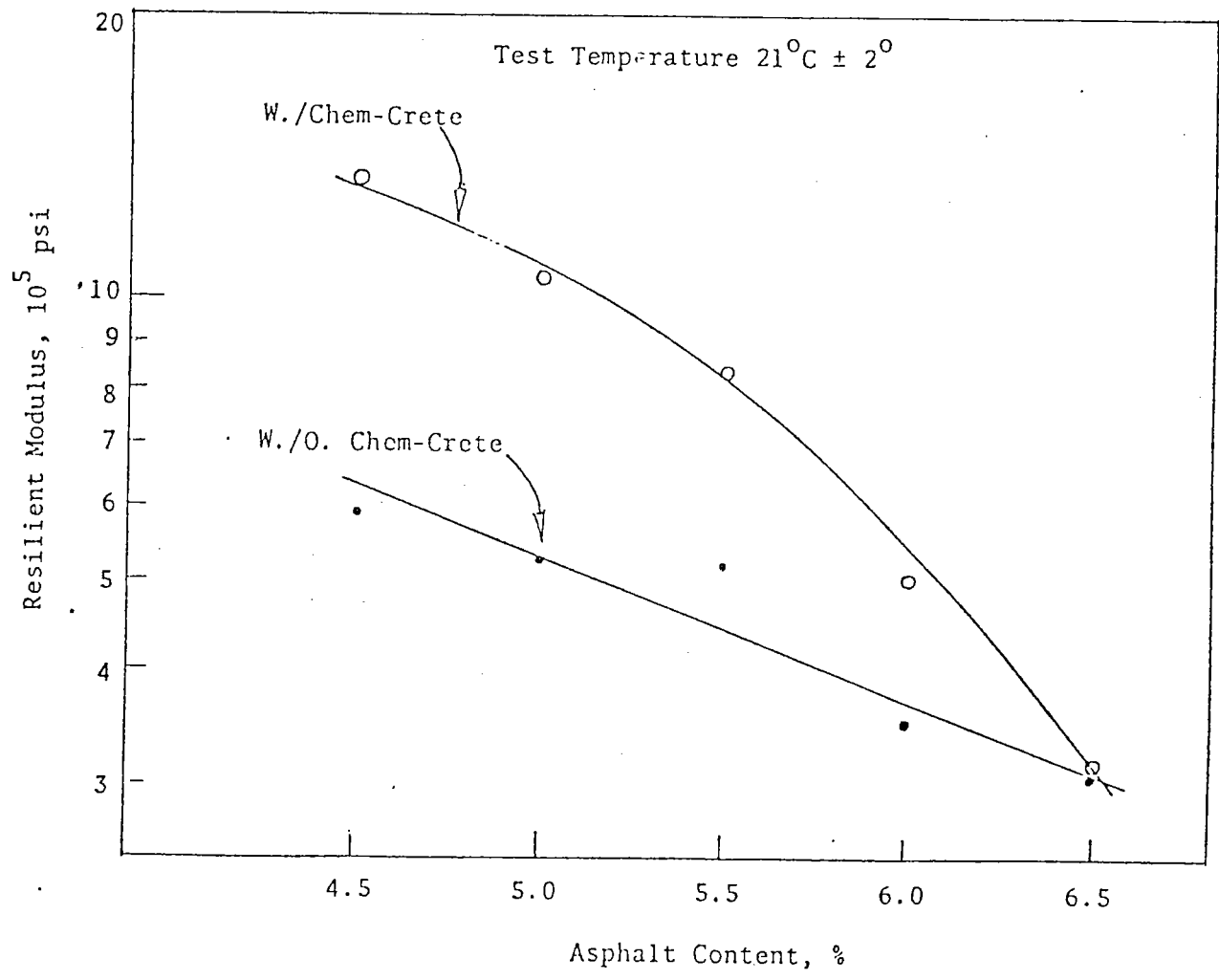


Figure 1. Resilient Modulus vs. Asphalt Content

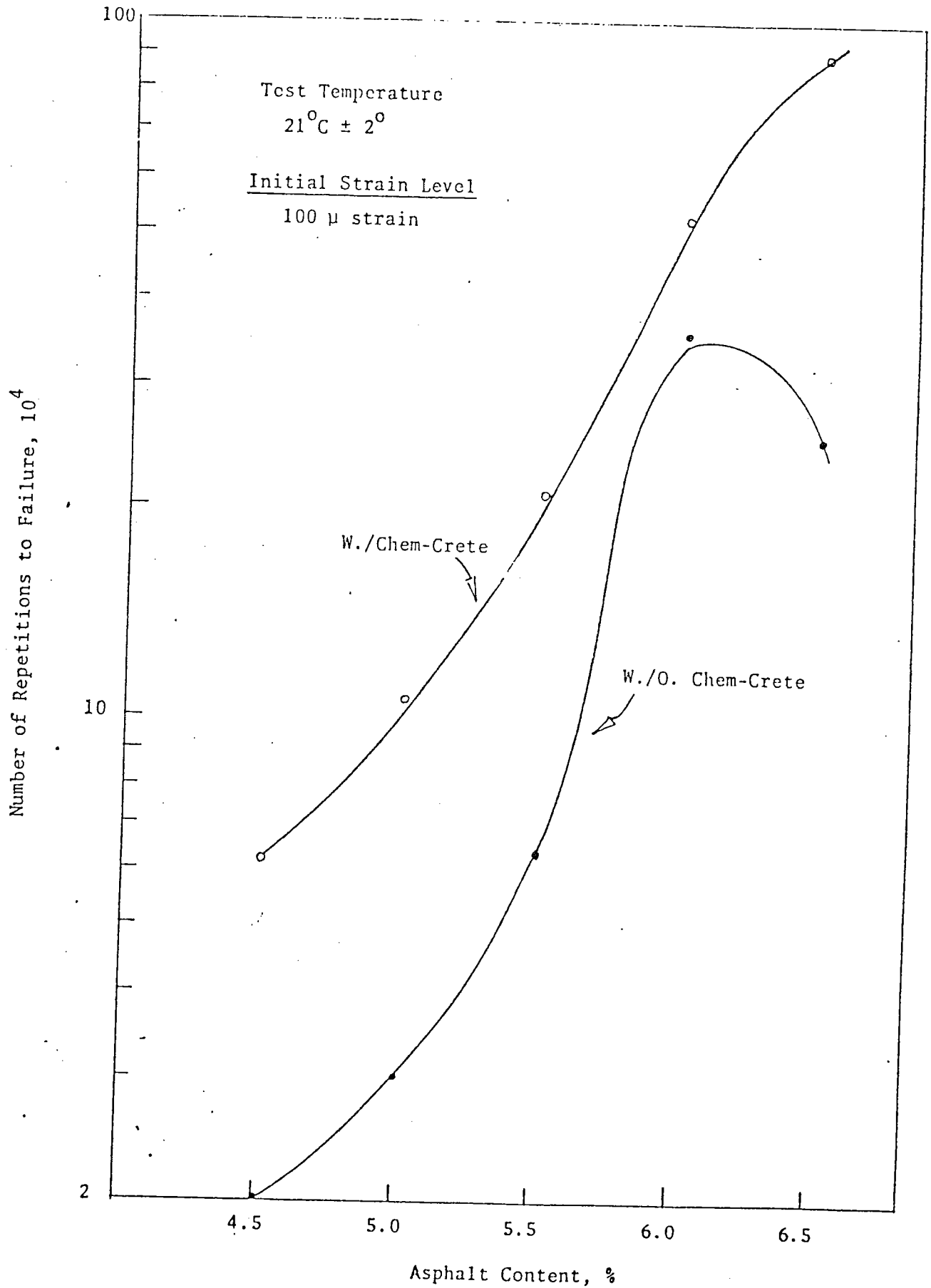


Figure 2. Number of Repetitions Vs. Asphalt Content

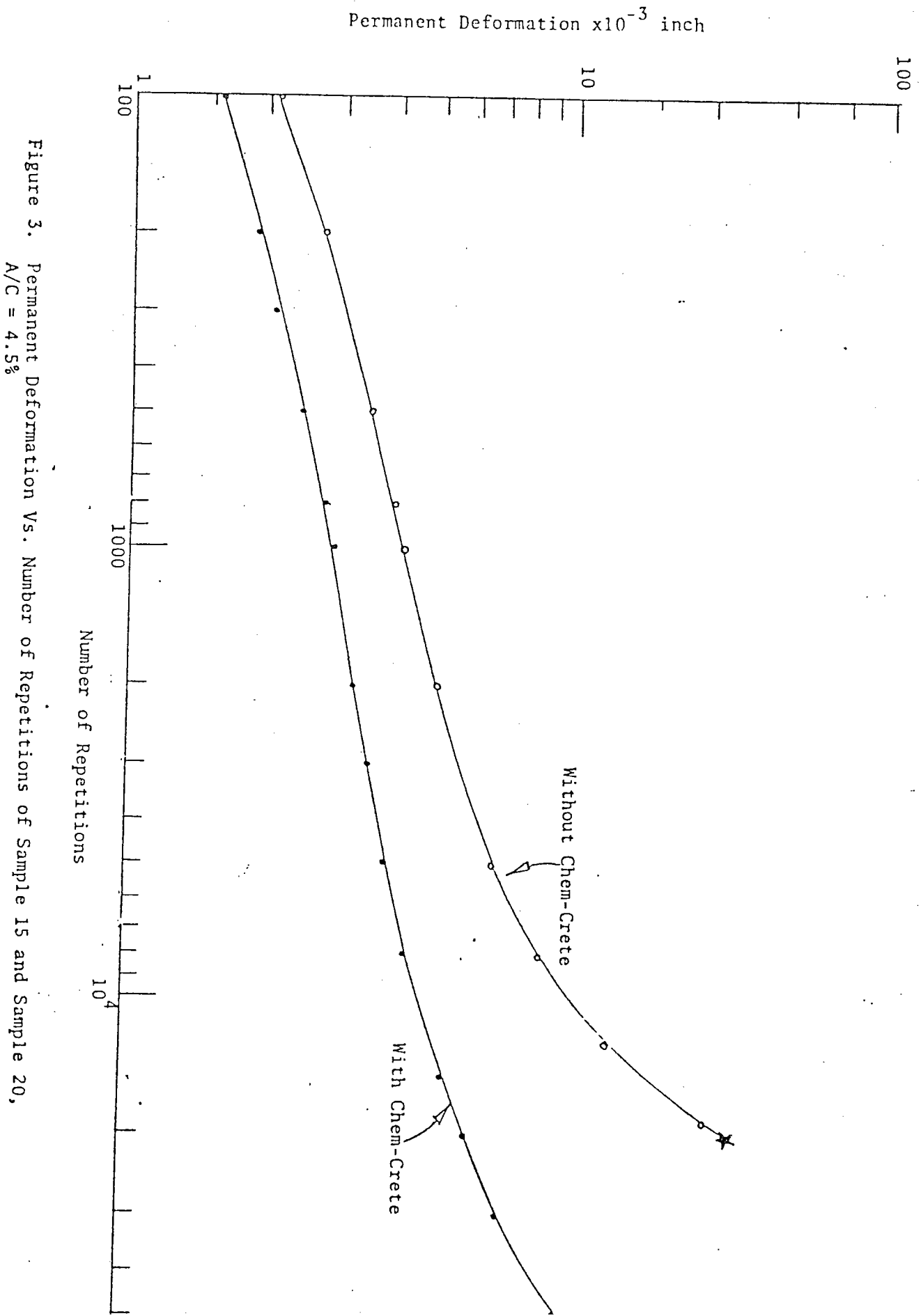


Figure 3. Permanent Deformation Vs. Number of Repetitions of Sample 15 and Sample 20, A/C = 4.5%

Permanent Deformation, 10^{-3} inch

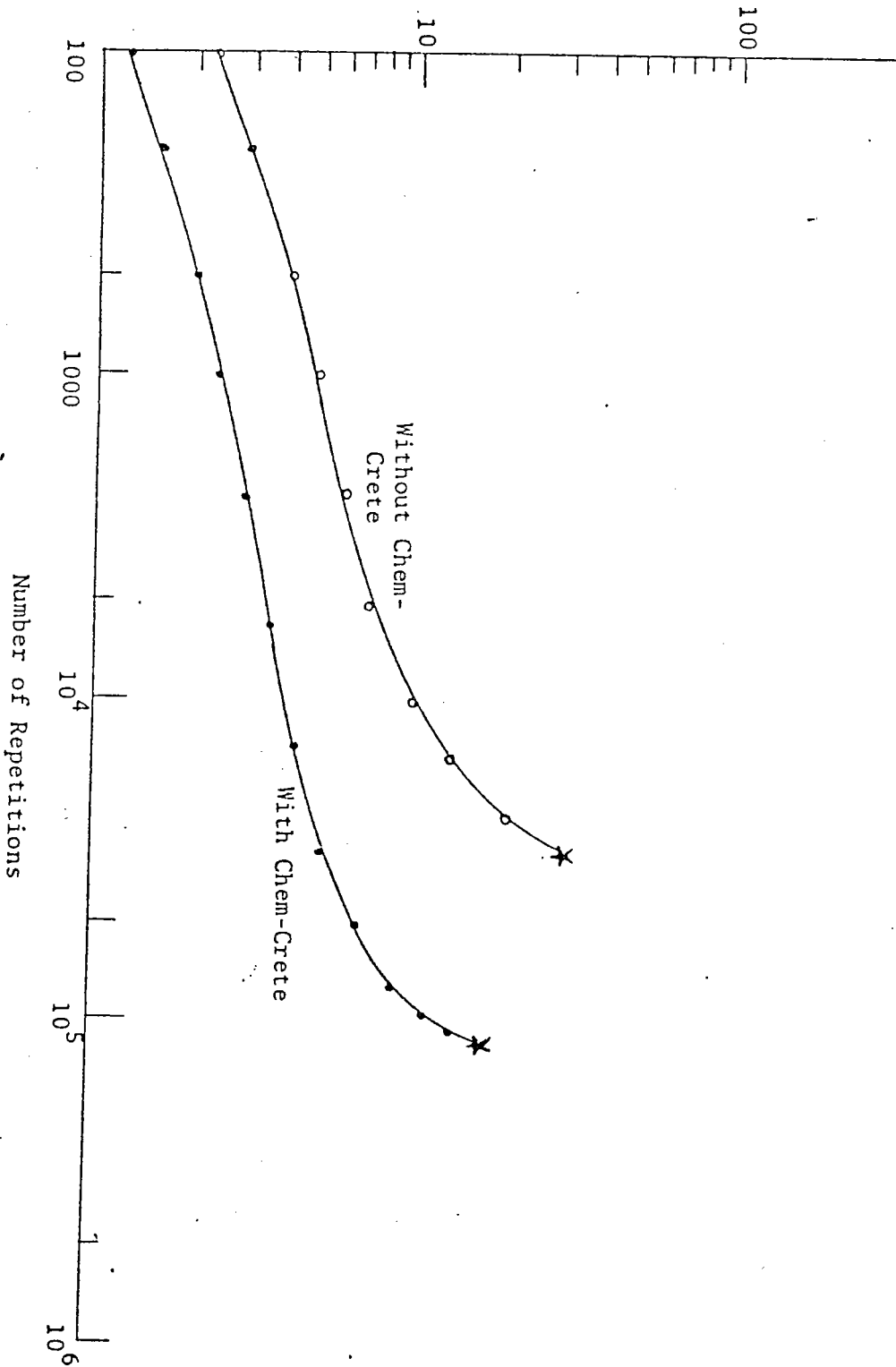


Figure 4. Permanent Deformation Vs. Number of Repetition of Sample 11 and Sample 16, A/C = 5.0%

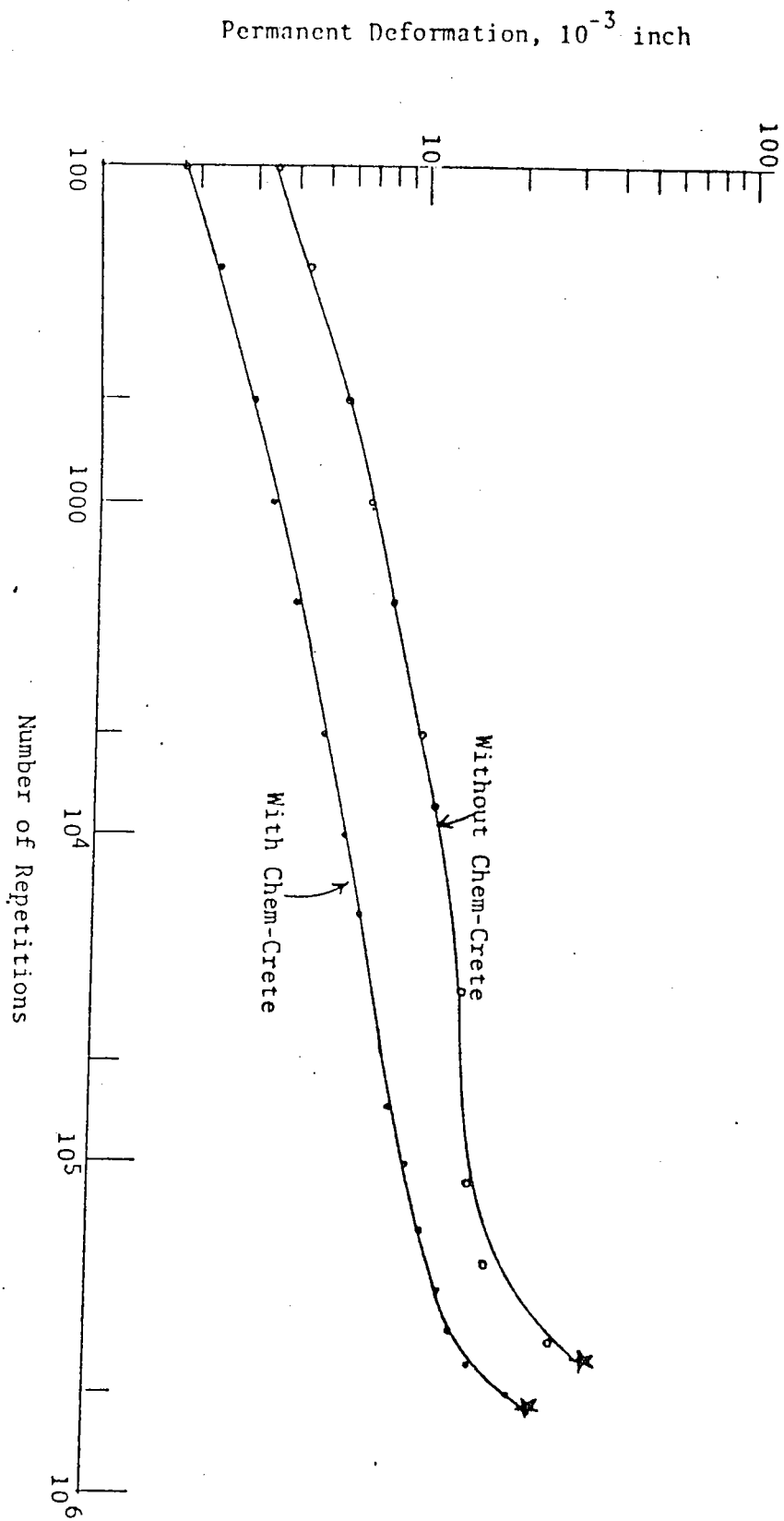


Figure 5. Permanent Deformation Vs. Number of Repetition of Sample 15 and Sample 16, A/C = 6.68

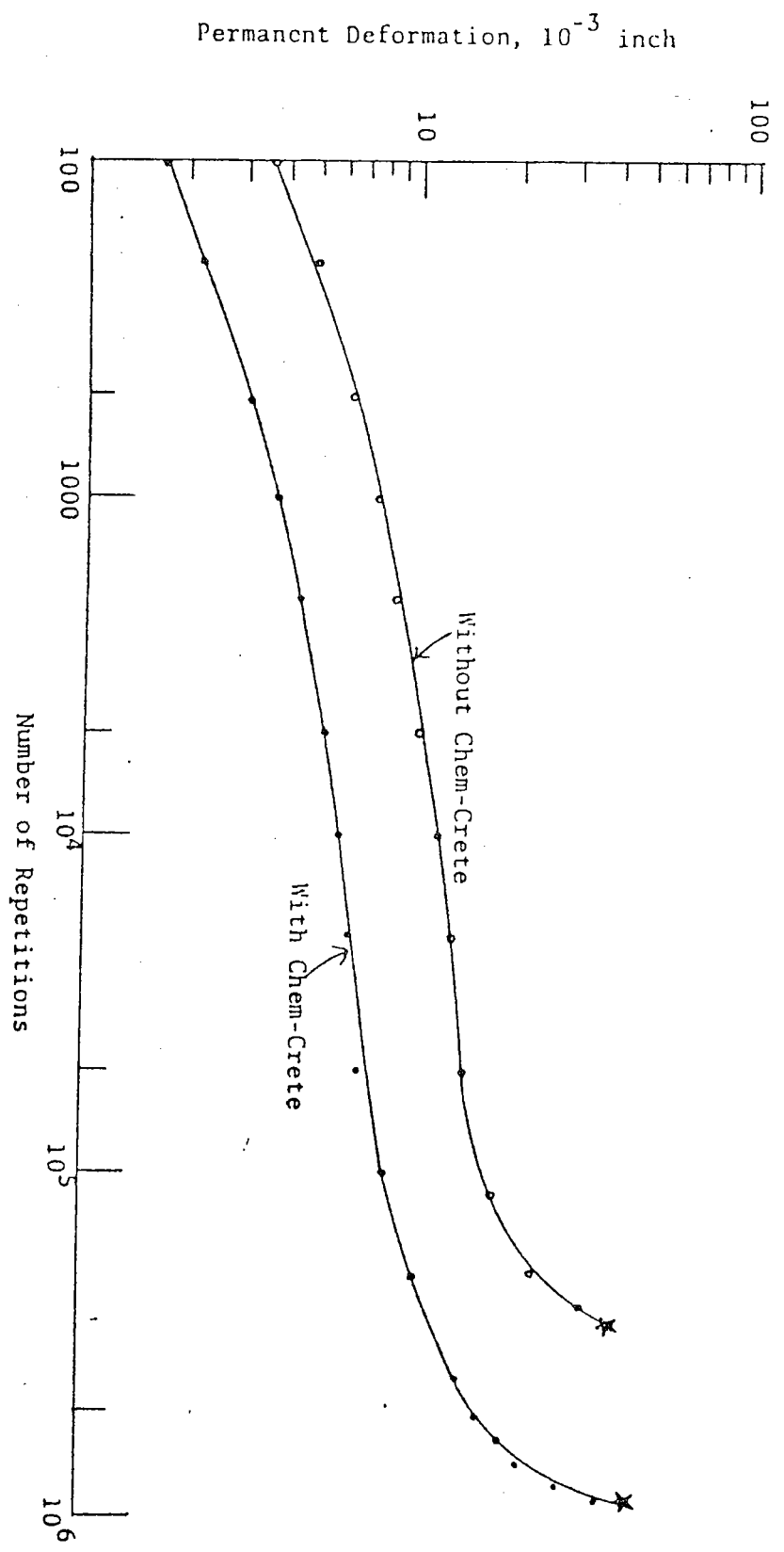


Figure 6. Permanent Deformation Vs. Number of Repetition of Sample 14 and Sample 19, A/C = 6.5%