A PRELIMINARY EVALUATION

OF

FATIGUE AND RESILIENT PROPERTIES

OF

CHEMCRETE-TREATED SPECIMENS

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In accordance with previous discussions, Chem-Crete supplied eight untreated asphalt and nine Chem-Crete-treated asphalt specimens containing granite aggregates.

One specimen from each group was tested to determine the indirect tensile strength. The strengths for the treated and untreated specimens were 281 and 176 psi, respectively. Based on these strengths, the remaining specimens (seven untreated and eight treated) were subjected to repeated stresses varying from 15 to 45 percent of the static tensile strength. The resulting lives, i.e., the number of load applications to failure, are shown in the attached table and in Figure 1. A series of horizontal and vertical resilient deformation measurements were made throughout the repeated-load tests. These values along with the applied repeated load were used to calculate resilient moduli of elasticity. The moduli corresponding to deformations taken from approximately 10 to 20 percent of the fatigue life are also shown in the attached table and in Figure 2.

Figure 1 illustrates the logarithm relationship between fatigue life and stress difference, approximately four times the applied tensile stress. As shown, these relationships were quite linear with high values of R^2. It can also be seen that the fatigue life under controlled stress loading conditions was significantly greater for the treated specimens.

The magnitude of this difference, however, decreased with increased stress level.

Assuming the fatigue relationships described by the equation

$$N_f = K_2' \left(\frac{1}{\Delta\sigma}\right) n_2$$

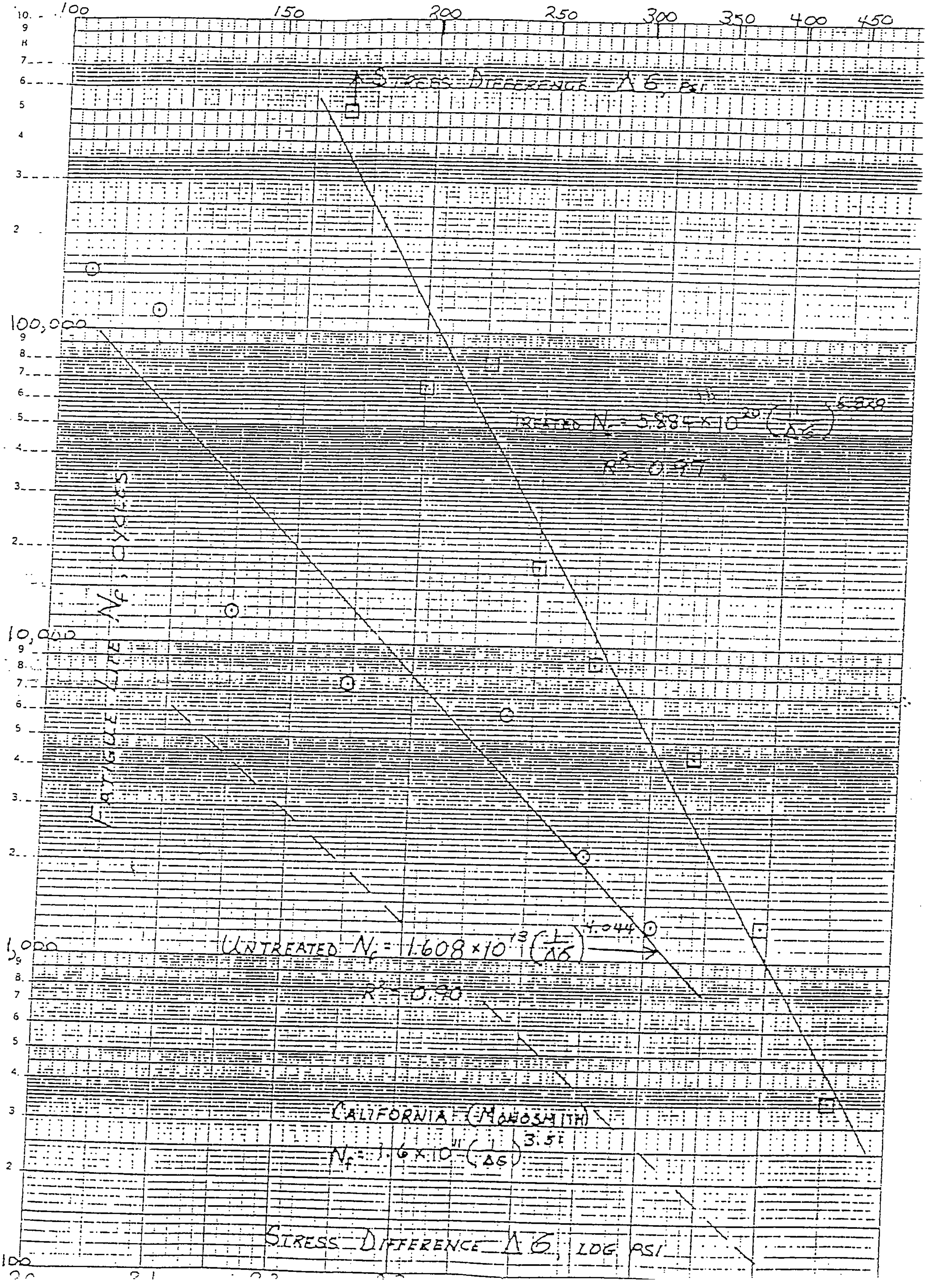
the values of K_2' and n_2 for the treated specimens were 5.9×10^{20} and 6.8 respectively, while for the untreated specimens these values were 1.6×10^{13} and 4.0. Typical values for silicious gravel and crushed limestone in Texas with an AC-10 tested at 75°F were 1.3×10^{10} and 4.7×10^{9} for K_2' and 3.46 and 3.19 for n_2. A typical value for asphalt mixtures from California tested at 68°F, were 1.6×10^{11} and 3.51 (Figure 1).

Resilient modulus values ranged from 0.628 to 1.208×10^{6} psi for the untreated specimens and 0.934 to 1.144×10^{6} psi for treated specimens. The average values were 0.855 and 1.070×10^{6} psi. Figure 2 illustrates the relationship between applied stress and resilient modulus. As shown, there appears to be a weak effect with modulus increasing with stress.

SUMMARY OF STATIC AND REPEATED-LOAD
INDIRECT TENSILE TEST RESULTS

Specimen Number	Treatment	Test Temperature °F	Tensile Strength S_T, psi	Applied Tensile Stress σ_T, psi	Stress Difference $\Delta\sigma$, psi	Fatigue Life N_f, Cycles	Resilient Modulus of Elasticity E_F 10^6 psi
5972	Untreated	68	--	44.0	176.0	7,403	0.906
5973	"	"	--	35.2	140.8	12,553	0.718
5995	"	"	176	--	--	--	--
5996	"	"	--	26.4	105.6	151,775	0.628
5997	"	"	--	60.0	240.0	6,058	0.855
5998	"	"	--	80.0	320.0	1,275	1.208
5999	"	"	--	70.0	280.0	2,130	0.878
6000	"	"	--	30.0	120.0	115,638	0.793
						MEAN	0.855
5974	Treated	68	--	42.2	168.8	500,000+	1.130
5975	"	"	--	112.4	449.6	361	
5976	"	"	--	70.3	281.2	8,714	
5977	"	"	281	--	--	--	--
5978	"	"	--	56.2	224.8	79,917	
5979	"	"	--	85.8	342.0	4,497	1.144
5980	"	"	--	98.4	393.6	1,299	1.122
5981	"	"	--	63.0	252.0	17,192	0.934
5982	"	"	--	50.0	200.0	63,558	1.019
						MEAN	1.070

8/80



100
150
200
250
300
350
400
450
100,000
10,000
1,000
100
STRESS DIFFERENCE Δσ, PSI
FATIGUE LIFE Nf, CYCLES
R² = 0.97
UNTREATED Nf = 1.608 × 10^13 (1/Δσ)^4.044
R² = 0.90
CALIFORNIA (MONOSMITH)
STRESS DIFFERENCE Δσ, LOG PSI

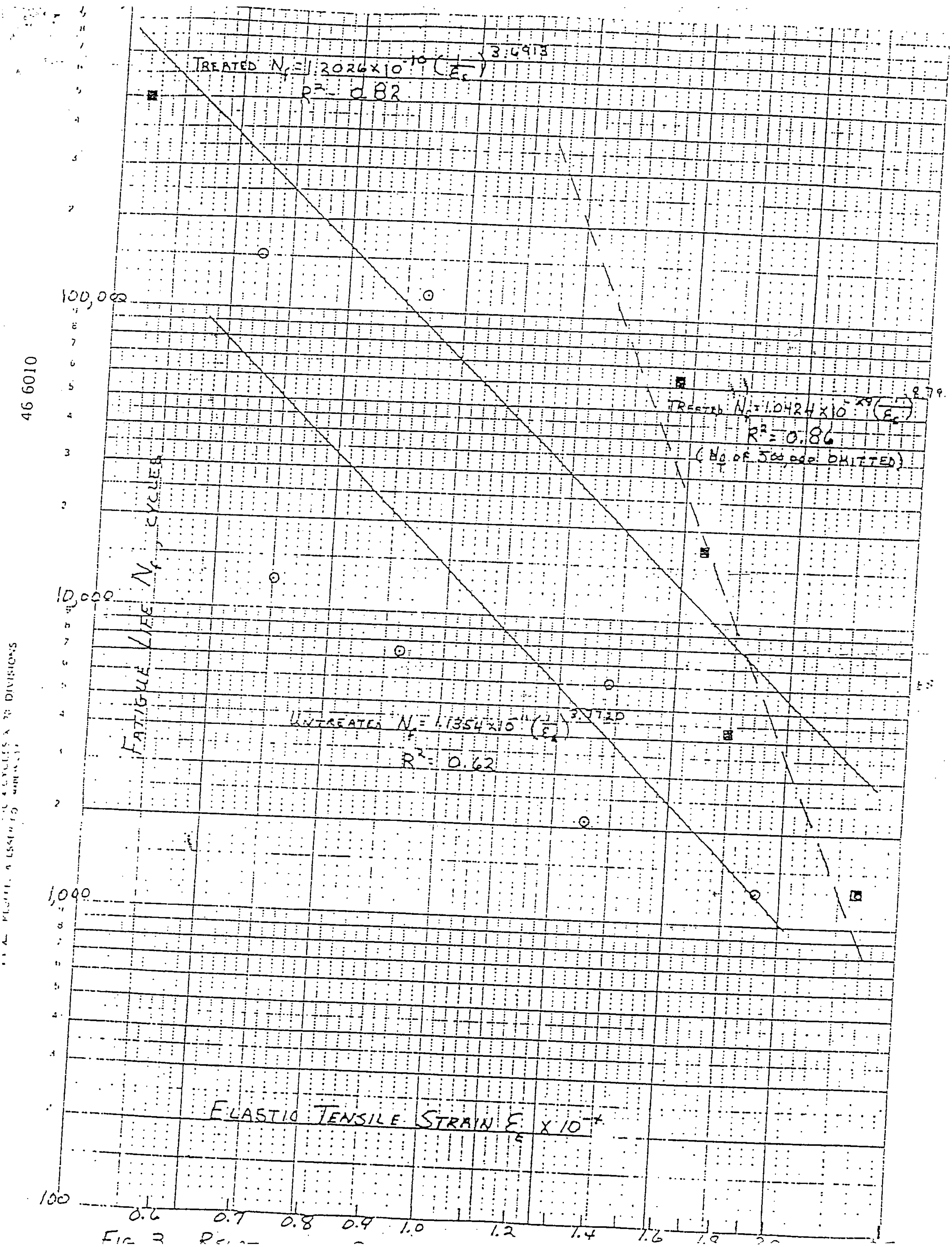

TREATED $N_f = 1.2026 \times 10^{-10} \left(\frac{1}{E_c}\right)^{3.6913}$
$R^2 = 0.82$
TREATED $N_f = 1.0424 \times 10^{-8} \left(\frac{1}{E_c}\right)^{2.79}$
$R^2 = 0.86$
(N_f OF 500,000 OMITTED)
UNTREATED $N_f = 1.1354 \times 10^{-11} \left(\frac{1}{E_c}\right)^{3.7720}$
$R^2 = 0.62$
FATIGUE LIFE N_f, CYCLES
ELASTIC TENSILE STRAIN $E_c \times 10^{-4}$
100,000
10,000
1,000
100
0.6
0.7
0.8
0.9
1.0
1.2
1.4
1.6
46 6010

FIG. 3 REL...

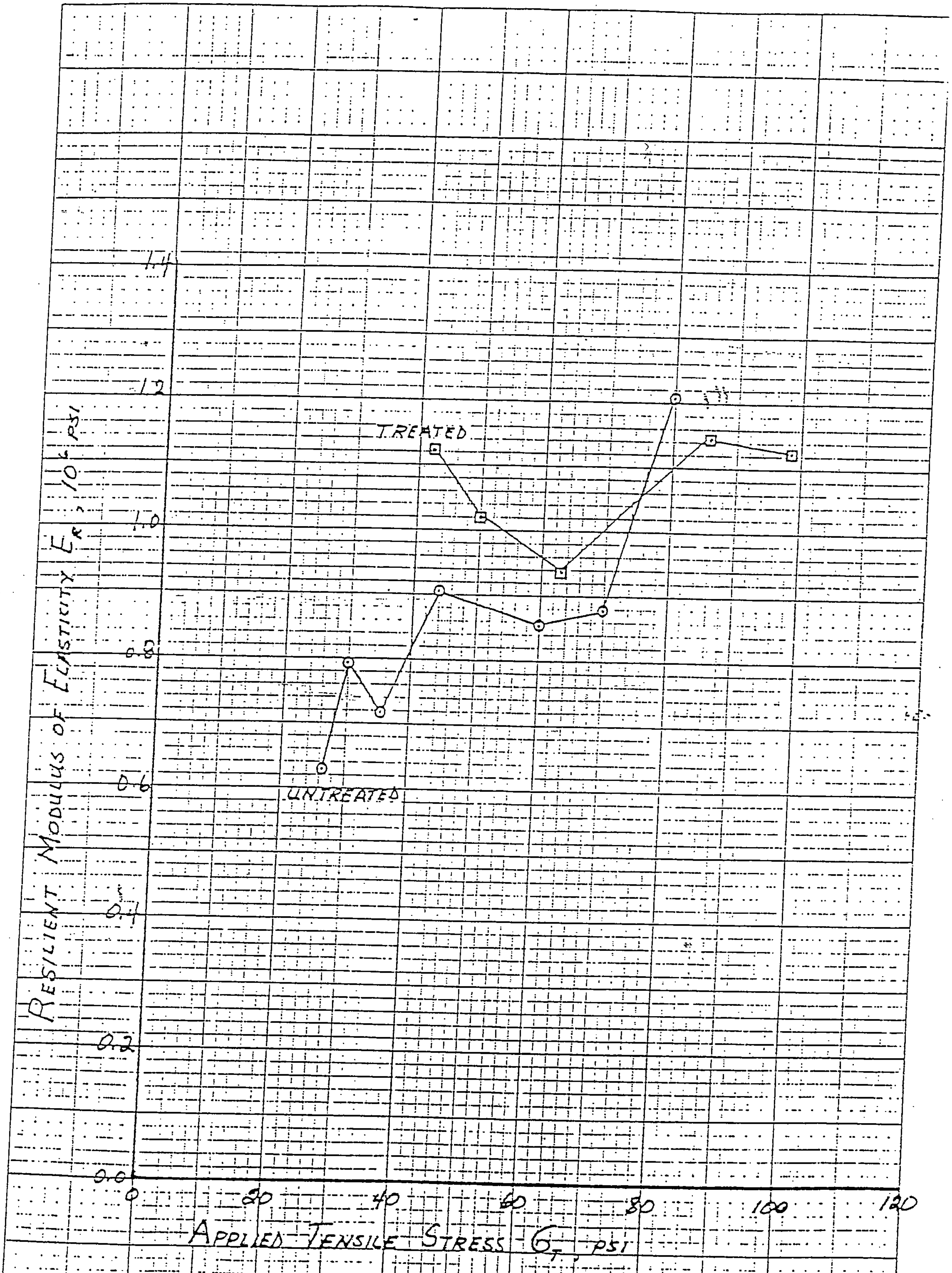


FIG 2. RELATIONSHIP BETWEEN RESILIENT MODULUS