

(SUP-9)

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A Study on High Temperature Fracture Toughness Characteristics of Spring Steel by Compressive Residual Stress

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Key Words: Shot Peening (), Compressive Residual Stress (), Plain Strain Fracture Toughness ((K_{IC}))

Abstract

High temperature fracture toughness characteristics of shot peened spring steel(SUP-9), which is used for automobile suspension system and railroad, was investigated in this paper. Fracture toughness test for room temperature, 100℃ and 200℃ were evaluated by material test system(MTS). The experimental results show that the fracture toughness was improved by peened and unpeened. The fracture toughness for high temperature were also improved by peened and unpeened.

1.

가

가

가

가

가

3~4)

1~2)

가

가

Xenophon⁵⁾

가

가

가

†

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*

(transfomation)

가

가

le 2

Table 2 Measuring condition of residual stress

X-Ray diffraction	Condition	
	Target	Cr-V
	Voltage	30kV
	Current	10mA
ϕ	0, 15, 30, 45°	
2θ	140° ~ 170°	
Diffraction	Scintillation counter	

가

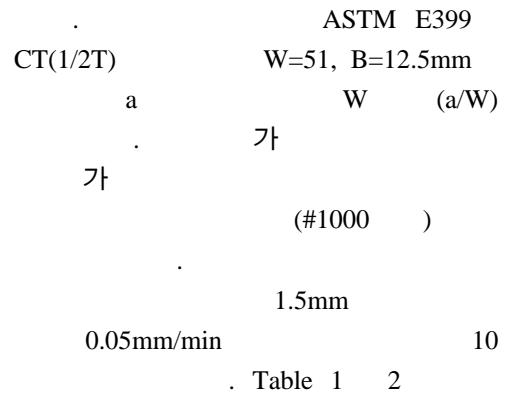
6)

가

26

2.3

Fig. 1



0

120

(Annealing)

가

가

(JISG SUP9)

가

100 , 200

15Hz,

1.5mm

, K_{IC}
0 , 200

0.05mm/min

10

Table 1 2

2.

2.1

Table 1

가

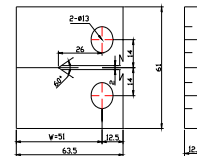


Table 1 Conditions of shot peening

	Impeller dia.[mm]	velocity		Shot ball dia.[mm]	Arc- height [mm]
		[m/sec]	[rpm]		
SUP9	490	70	2200	0.8	0.39

Fig. 1 Fracture toughness test specimen

2.2

Table 2 Chemical compositions of specimen

X-

	C	Si	Mn	P	S	Cr	Cu
SUP9	0.56	0.25	0.84	0.016	0.009	0.88	-

Table 3 Mechanical properties of specimen

Material	σ_{UTS}	Hardness(HRC)		σ_{YS}	Elong. [%]
		after quenching	after tempering		
JISG SUP-9	1225	55	47	1079	9

3.

3.1

Fig. 2

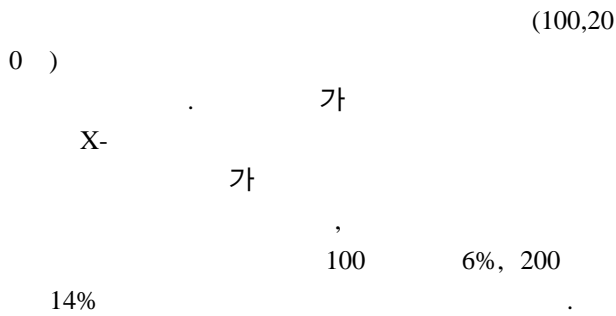


Fig. 2 Compressive residual stress distributions of specimen surface

3.2

Fig. 3, 4, 5

100 , 200

101.55, 100
 100.79, 200 90.94MPa-m^{0.5}
 100 100
 가 가 가
 , 200 가
 10%
 100
 , 200
 A₀

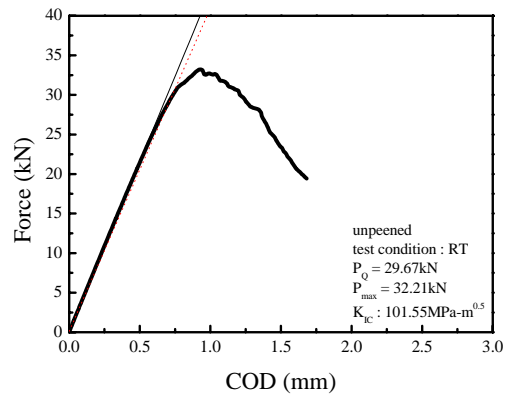


Fig. 3 Results of fracture toughness test in unpeening (RT)

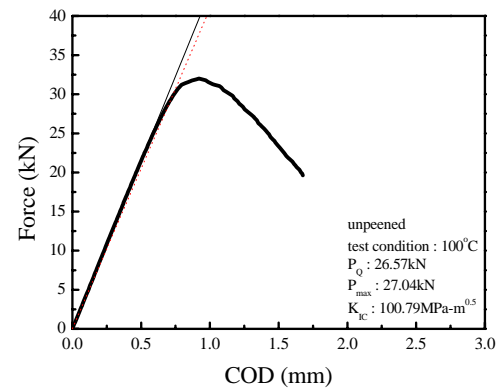


Fig. 4 Results of fracture toughness test in unpeening (100)

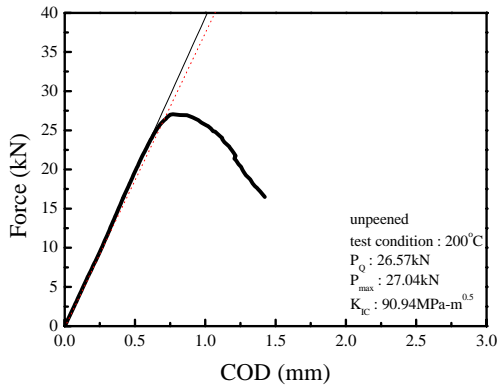


Fig. 5 Results of fracture toughness test in unpeening (200)

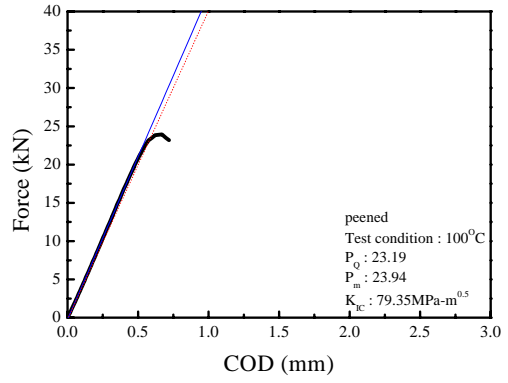


Fig. 7 Results of fracture toughness test in peening (100)

3.3

Fig. 6, 7, 8

100 , 200

100 , 200
78.75, 79.35, 83.95Mpa-m^{0.5}

100 가

200 가

, 200

가

200

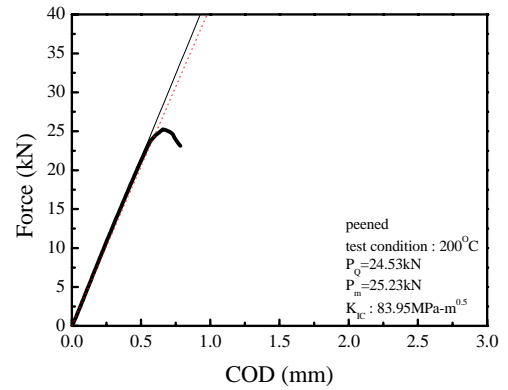


Fig. 8 Results of fracture toughness test in peening (200)

4.

4.1

Fig. 8

SEM

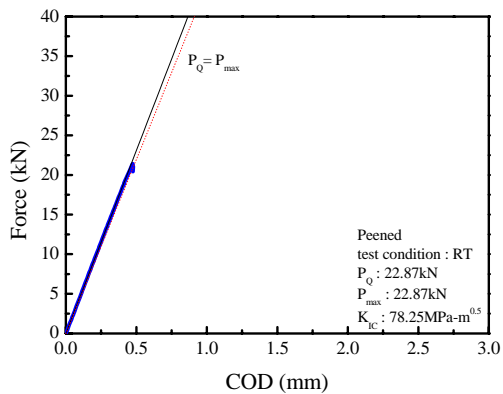


Fig. 6 Results of fracture toughness test in peening (RT)

0

, 200

200 가

10

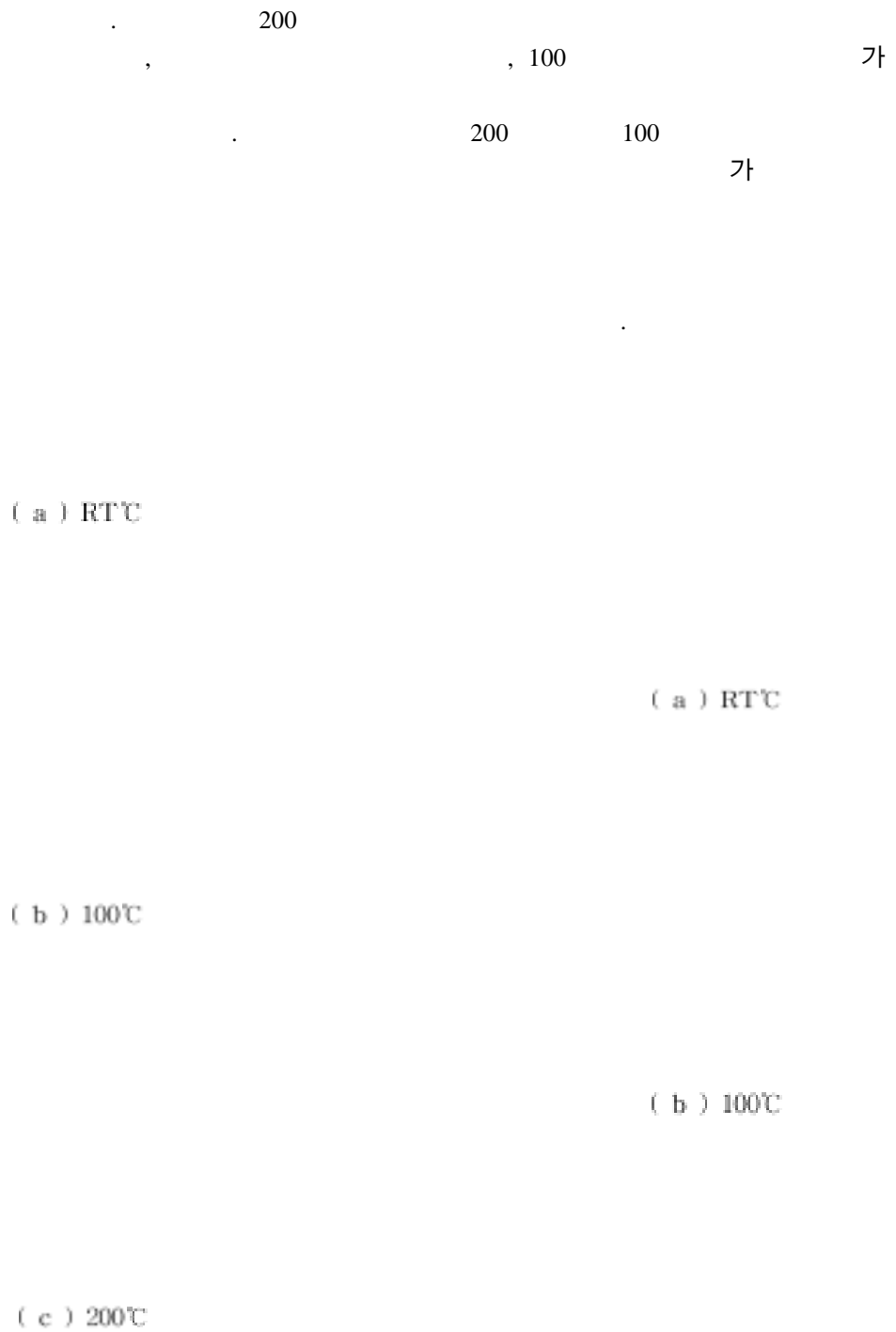


Fig. 8 Photographs of fracture plane (RT, 100, 200)

4.2
Fig. 9

Fig. 9 Photographs of fracture plane (RT, 100, 200)

5.

(SUP9)

(1)

가
6%, 14%

(2)

0 가 >100 >20
가
0 >100 > 20

(3)

가
가

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