

1

2

3

.

가

28

(10)

,

400m

가

(4,000m).

400m 5 ,

2,000m .

가

(-50%)

가

가

-30%,

+50%,

+200%

.

1.1

(U%)

(CV%)

<

1>

<

2>

,

.

가

:

$$U_n = \frac{U_1}{\sqrt{n}}, \quad CV_n = \frac{CV_1}{\sqrt{n}} \quad (1)$$

, U1 =

, Un = n

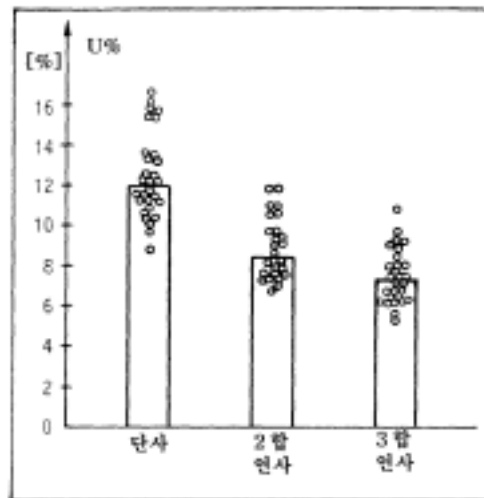
, n =

,

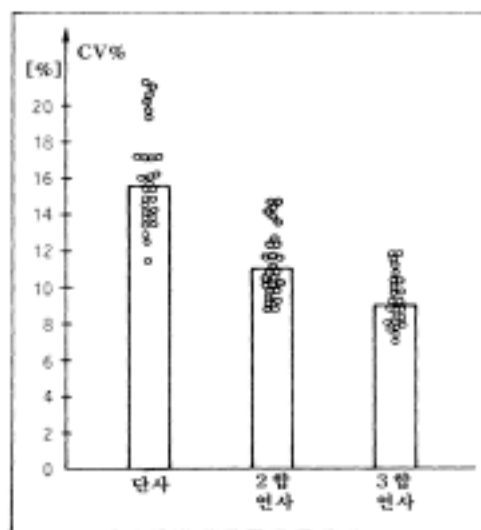
, CV1 =

, CVn = n

< 1> < 2> . <
 1> U% 12%, 2 8.5%, 3
 7% , < 2> CV% 14.7%, 2
 11%, 3 9% .



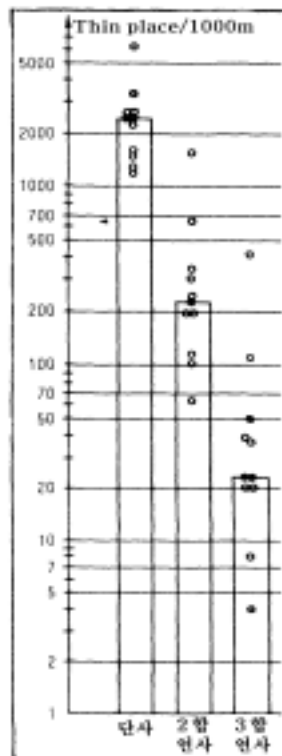
< 1> , 2 3 U%



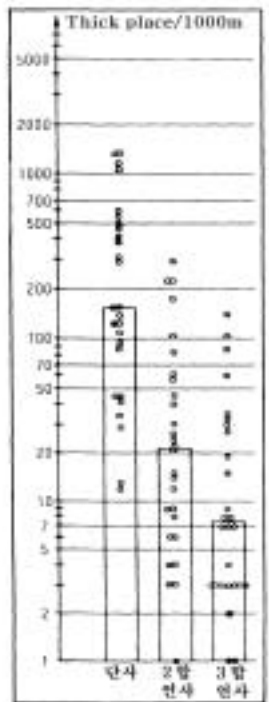
< 2> , 2 3 CV%

1.2

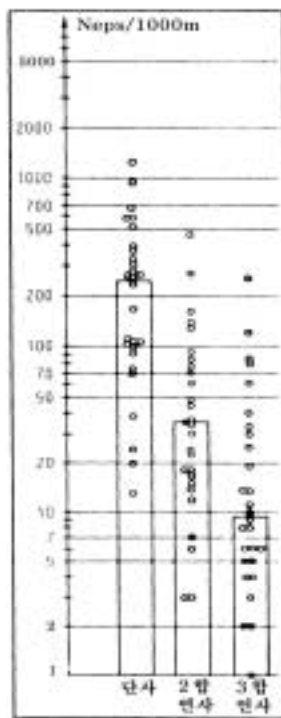
$\langle 3 \rangle \sim \langle 5 \rangle$,
 가 가 , 2
 3 가
 .
 : 2 3 +60%
 , 2 가 +30%, 3 +20%가
 .



$\langle 3 \rangle$, 2 3 가 /1,000m



< 4> , 2 3 /1,000m



< 5> , 2 3 /1,000m

가

, 가

:

$$\log Z_n = \log Z - k \log n \quad (2)$$

, $Z =$, $Z_n =$, $n =$, $k =$

, $k = 3$

(2) 가 .

$$Z_2 = \frac{Z_1}{8} : 2 \quad (3)$$

$$Z_3 = \frac{Z_1}{27} : 3 \quad (4)$$

가 , $k = 4$ (2) 가

가 .

$$Z_2 = \frac{Z_1}{16} : 2 \quad \text{가} \quad (5)$$

$$Z_3 = \frac{Z_1}{81} : 3 \quad \text{가} \quad (6)$$

() +50% 가 1,000m 380

, 3 가 가?

(4) 3

$$Z_3 = \frac{Z_1}{27} = \frac{380}{27} = 14 \text{ /1,000m}$$

() -30% 가 가 1000m 3079

, 3 가 가 가?

(6) 3 가

$$Z_3 = \frac{Z_1}{81} = \frac{3079}{81} = 38 \quad /1,000m$$

2

2 3

Ne 39

< 6>

. (α_e) 가 0, 가 가

, ,

가 가

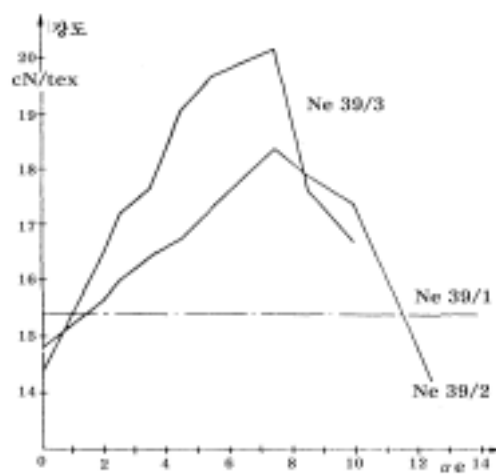
. 가

가 .

가 1~2 가

. 가 7.5 ,

(over-twisting) .



< 6> , 2 3

가

가

.

2.0,

2.5

.

가

,

가

.

가

가

.

가

(7).

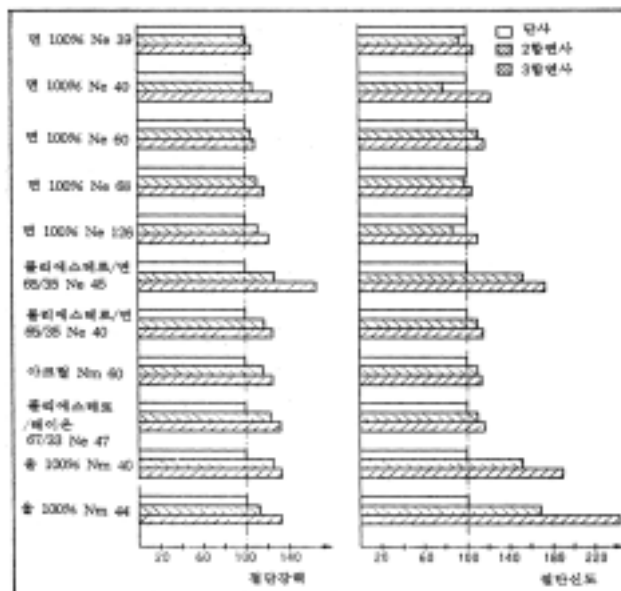
가

, < 7>

,

가

.



< 7> , 2 , 3

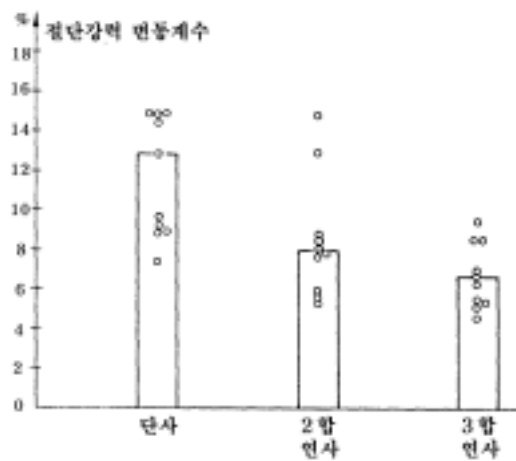
< 7> 가
 , 2 가
 , 3 가 . ,
 2 3 가 가
 .

:

$$CV_n = \frac{CV_1}{\sqrt{n}} \quad (8)$$

, CV1 = CVFmax, CVn = n CVFmax, n =

< 8> , 2 3
 ,
 .



< 8> , 2 3

3

,

.

,

()

2

3

,

가

가

.