

## CHAPTER 5

### RESULTS

#### 5.1 Results of Batch Experiment

##### 5.1.1 Result of determination of NCO/OH ratio

The experimental results of this part are shown in Table 5.1 and Figure 5.1. Tensile strength and percentage of elongation at break increase with NCO/OH ratio to maximum values, then begin to decrease while NCO/OH ratio increases further. Hardness increases while NCO/OH ratio increases.

The maximum tensile strength and hardness are obtained at NCO/OH ratio of 1.11 but the maximum value of percentage of elongation at break is obtained at NCO/OH ratio of 1.02.

Table 5.1 Result of determination of NCO/OH ratio

NCO/OH ratio	Tensile strength ( MPa )	Elongation at break ( % )	Hardness ( Shore °A )
0.90	3.061	126	45
0.93	5.354	138	53
0.96	7.135	138	62
0.99	8.697	142	68
1.02	10.668	150	70
1.05	10.405	136	75
1.08	11.824	129	76
1.11	11.977	127	78
1.14	9.036	120	77

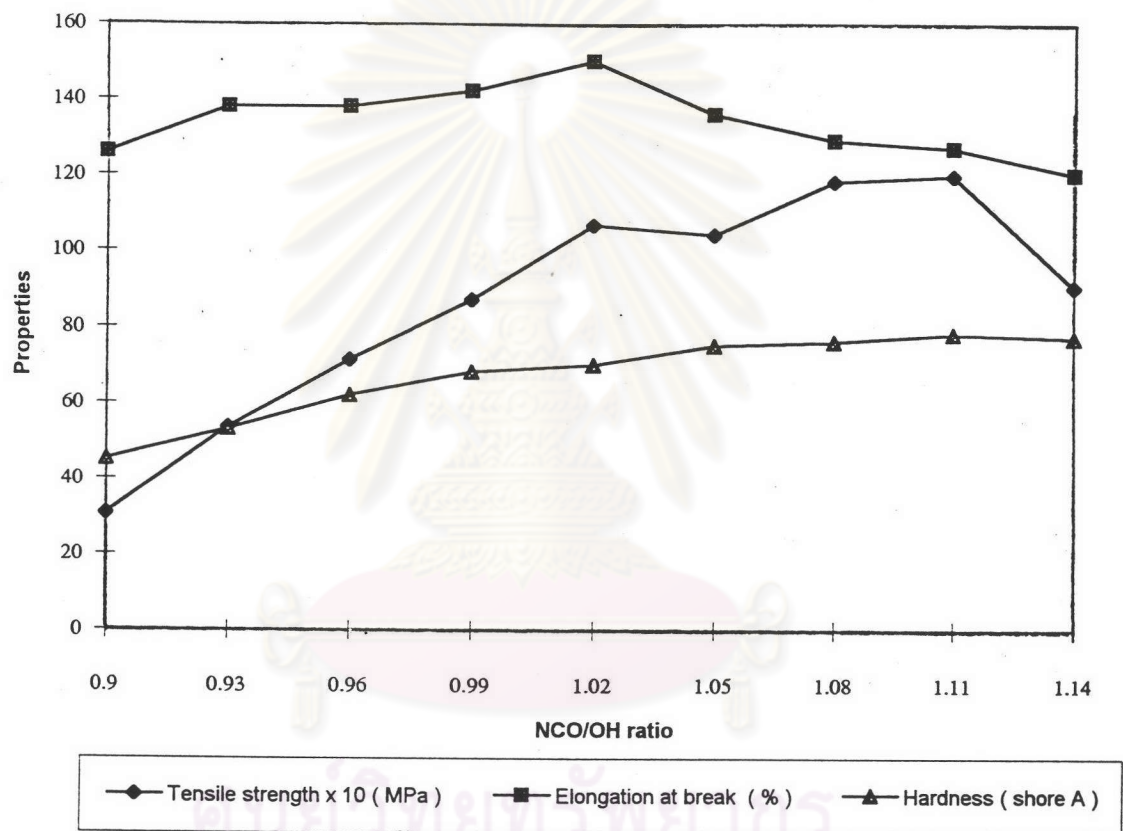


Figure 5.1 Effect of NCO/OH ratio on mechanical properties of unfilled-polyurethane

### 5.1.2 Results of Determination of Molar ratio

In Table 5.2 and Figure 5.2, the results of various molar ratio of polyester polyol : MDI : DEG from 1:2:1 to 1:6:5 at a fixed NCO/OH ratio of 1.02 are presented. In Table 5.3 and Figure 5.3, the results of various molar ratio of polyester polyol : MDI : DEG from 1:2:1 to 1:6:5 at a fixed NCO/OH ratio of 1.11 are presented.

From Table 5.2 - 5.3 and Figure 5.2-5.3, both NCO/OH ratios at 1.02 and 1.11 give curves having the maximum values of percentage of elongation at break and tensile strength at molar ratio of polyester polyol : MDI : DEG of 1:4:3.



ศูนย์วิทยทรัพยากร  
จุฬาลงกรณ์มหาวิทยาลัย

Table 5.2 Result of determination of molar ratio  
at NCO/OH ratio of 1.02

Molar ratio of Polyol:MDI:DEG	Tensile strength ( MPa )	Elongation at break ( % )	Hardness ( Shore °A )
1:2:1	1.750	112	40
1:3:2	6.428	129	46
1:4:3	10.668	150	70
1:5:4	9.384	125	78
1:6:5	8.037	117	80

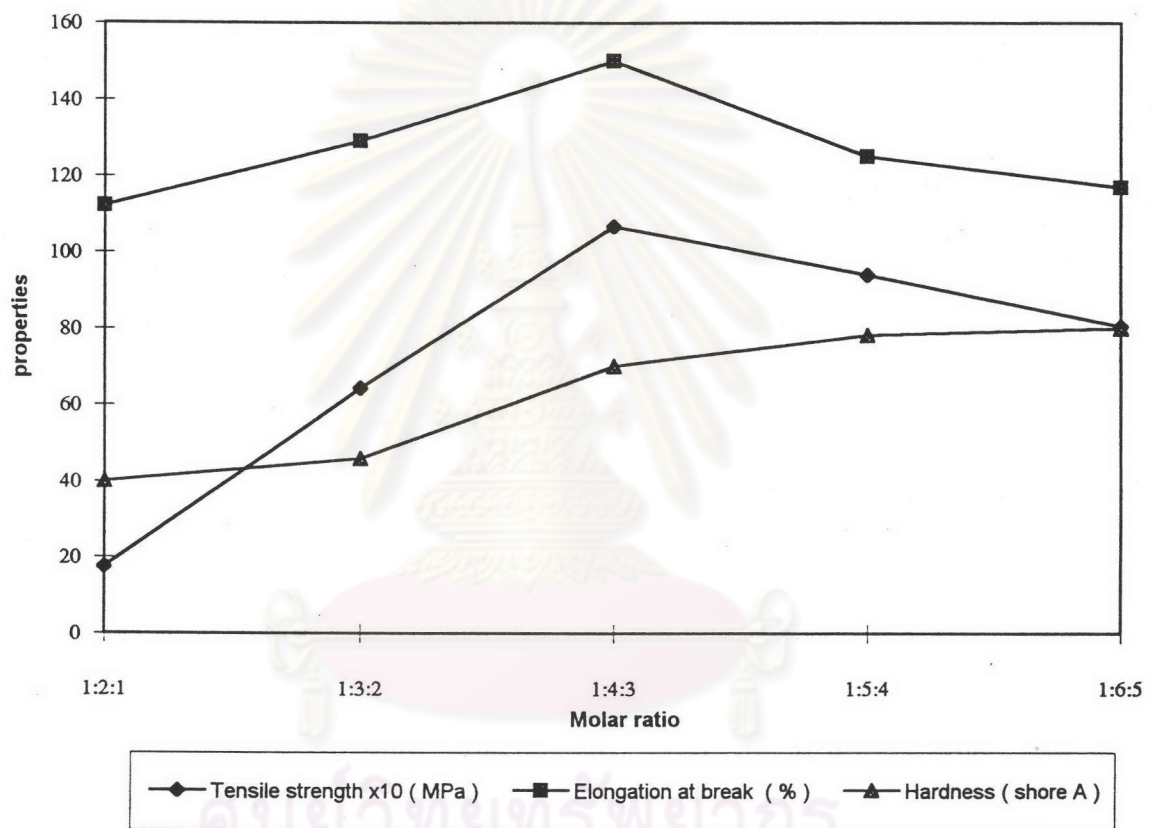


Figure 5.2 Effect of molar ratio on mechanical properties at NCO/OH ratio of 1.02

Table 5.3 Result of determination of molar ratio  
at NCO/OH ratio of 1.11

Molar ratio of Polyol:MDI:DEG	Tensile strength ( MPa )	Elongation at break ( % )	Hardness ( Shore °A )
1:2:1	2.827	118	44
1:3:2	6.849	121	53
1:4:3	11.977	127	78
1:5:4	10.214	113	84
1:6:5	8.732	108	82

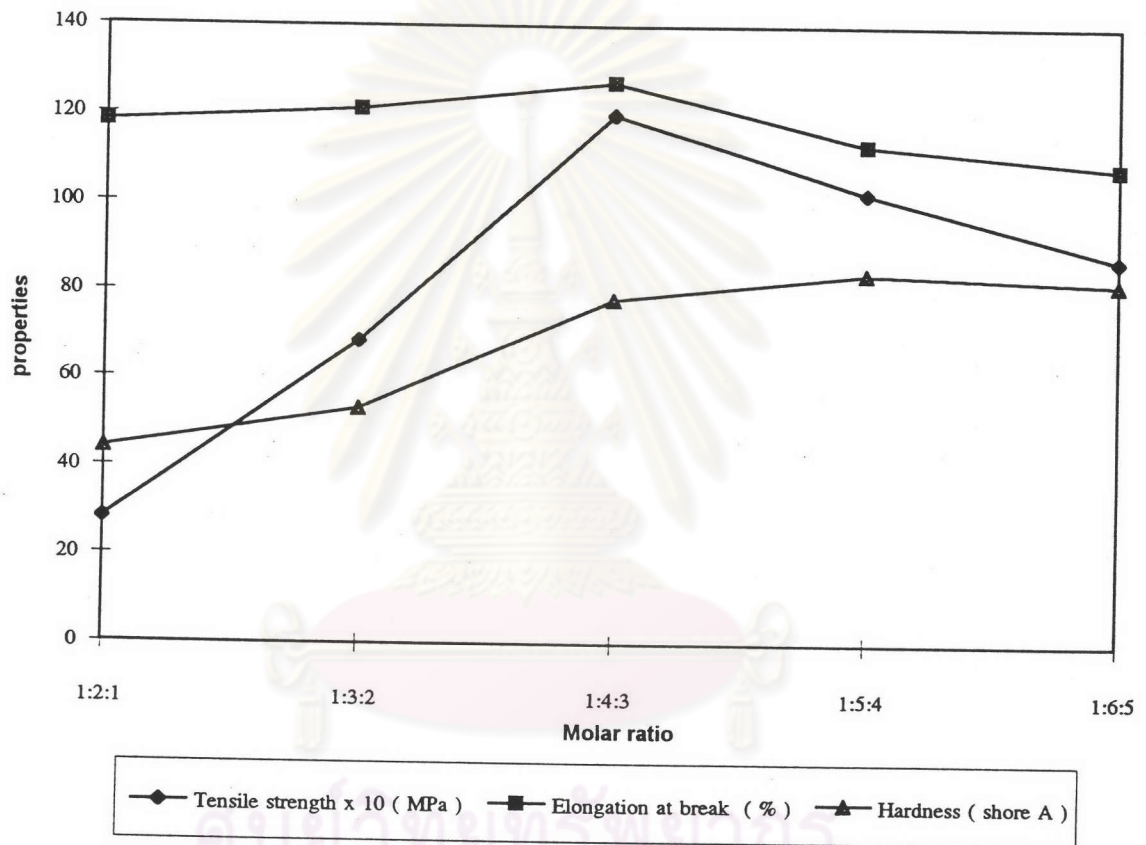


Figure 5.3 Effect of molar ratio on mechanical properties at NCO/OH ratio of 1.11

### 5.1.3 Results of Determination of Quantity of Brick powder

In Table 5.4 and Figure 5.4, the results of various weight percentage bricks powder at a fixed molar ratio of polyester polyol : MDI : DEG of 1:4:3 and a fixed NCO/OH ratio of 1.02 are obtained. For the same molar ratio, another results in the case of a fixed NCO/OH ratio of 1.11 is obtained in Table 5.5 and Figure 5.5. As the percentage of bricks powder content increases, the hardness of the product increases while the tensile strength and percentage of elongation at break decrease.



คุรุวิทยาลัย  
จุฬาลงกรณ์มหาวิทยาลัย



Table 5.4 Result of determination of quantity of brick powder at a fixed molar ratio of polyol:MDI:DEG of 1:4:3 and a fixed NCO/OH ratio of 1.02

% Brick	Tensile strength (MPa)	Elongation at break (%)	Hardness (Shore °A)
0	10.668	150	70
5	9.952	118	73
10	9.383	107	75
15	8.953	94	79
20	8.114	81	80
25	7.895	79	81

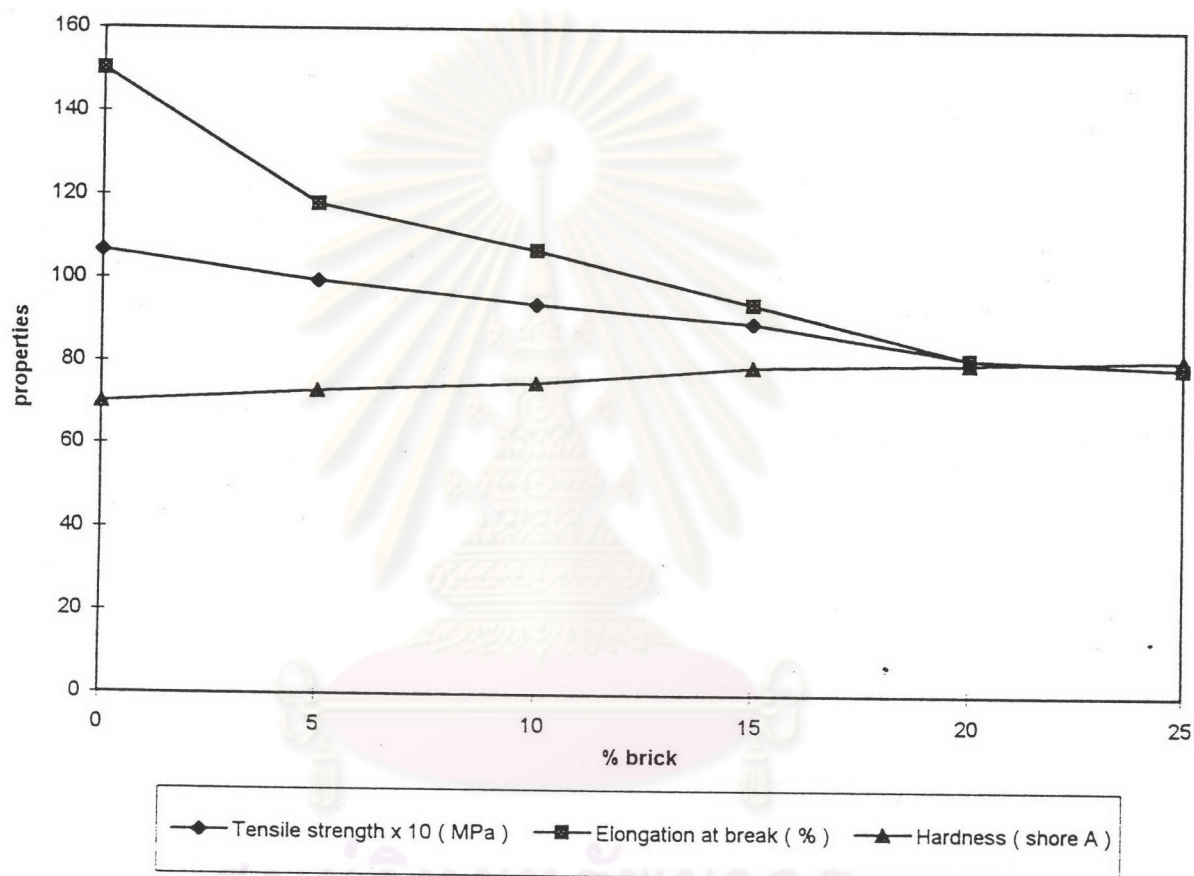


Figure 5.4 Effect of various weight % brick on mechanical properties with a fixed NCO/OH ratio of 1.02 and a fixed molar ratio of polyol:MDI:DEG of 1:4:3

Table 5.5 Result of determination of quantity of brick powder at a fixed molar ratio of polyol:MDI:DEG of 1:4:3 and a fixed NCO/OH ratio of 1.11

% Brick	Tensile strength ( MPa )	Elongation at break ( % )	Hardness ( Shore °A )
0	11.977	127	78
5	11.083	108	80
10	9.832	92	81
15	8.952	87	83
20	7.845	81	83
25	7.103	78	84

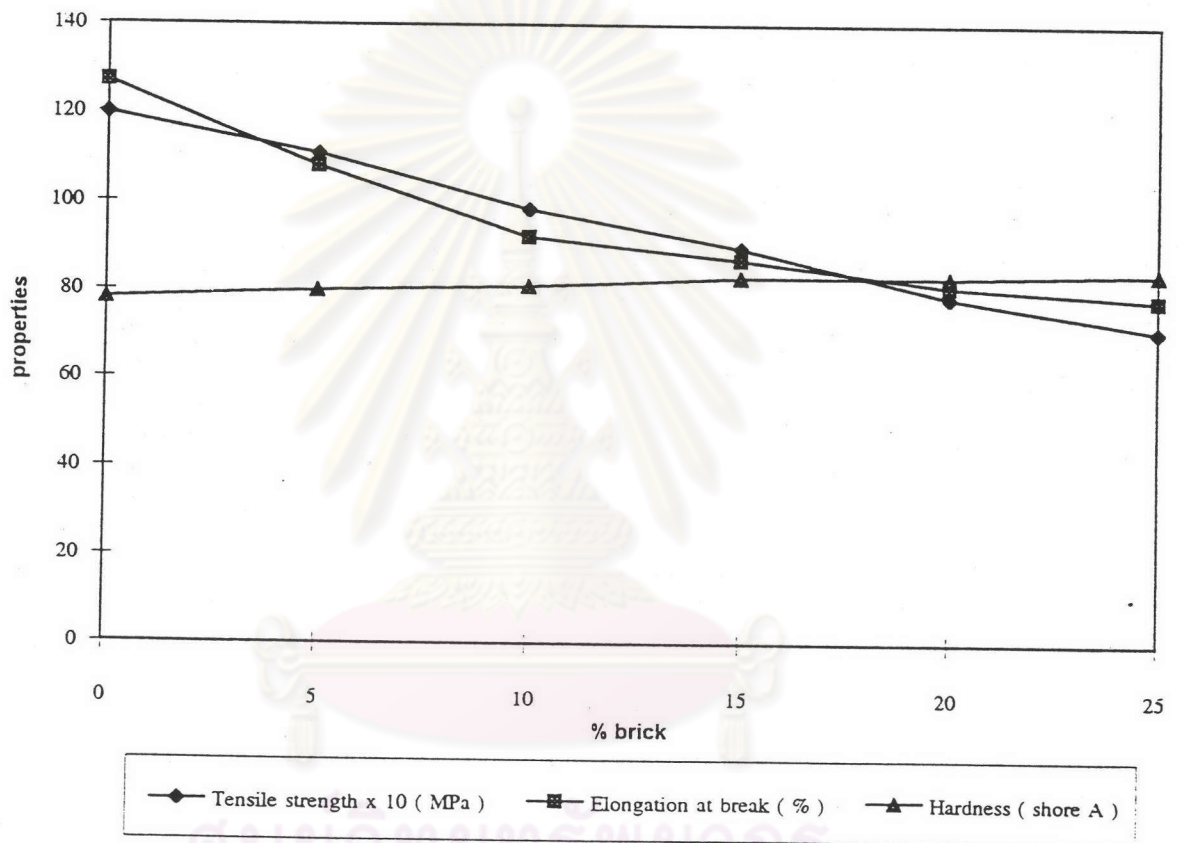


Figure 5.5 Effect of various weight % brick on mechanical properties with a fixed NCO/OH ratio of 1.11 and a fixed molar ratio of polyol:MDI:DEG of 1:4:3

## 5.2 Result of Continuous Experiment

The result of this experiment(at NCO/OH ratio of 1.02, molar ratio of polyol:MDI:DEG of 1:4:3 and 0 % brick powder) is shown in Table 5.6 and Figure 5.6. In Table 5.6 and Figure 5.6, the values of mechanical properties(tensile strength, percentage of elongation at break and hardness) of product samples at different times are relatively consistent with mean values of 9.698 MPa, 143.83 % and 68.17 shore°A, respectively and deviation from the mean of  $\pm 1.051$  MPa,  $\pm 5.83$  % and  $\pm 5.83$  shore°A respectively.

These mechanical properties of the samples are slightly inferior to those of the batch experiment.



ศูนย์วิทยทรัพยากร  
จุฬาลงกรณ์มหาวิทยาลัย

Table 5.6 Result of continuous experiment  
 ( NCO/OH ratio at 1.02, Molar ratio of Polyol:MDI:DEG = 1:4:3 and 0 % Brick )

Time ( Min. )	Tensile strength ( MPa )	Elongation at break ( % )	Hardness ( Shore °A )
1	9.425	148	71
2	8.647	139	68
3	9.902	145	67
4	10.054	147	74
5	8.923	142	67
6	9.744	139	65
7	10.187	145	68
8	9.966	148	68
9	9.915	145	69
10	9.801	145	66
11	10.239	138	68
12	9.578	145	67

จุฬาลงกรณ์มหาวิทยาลัย

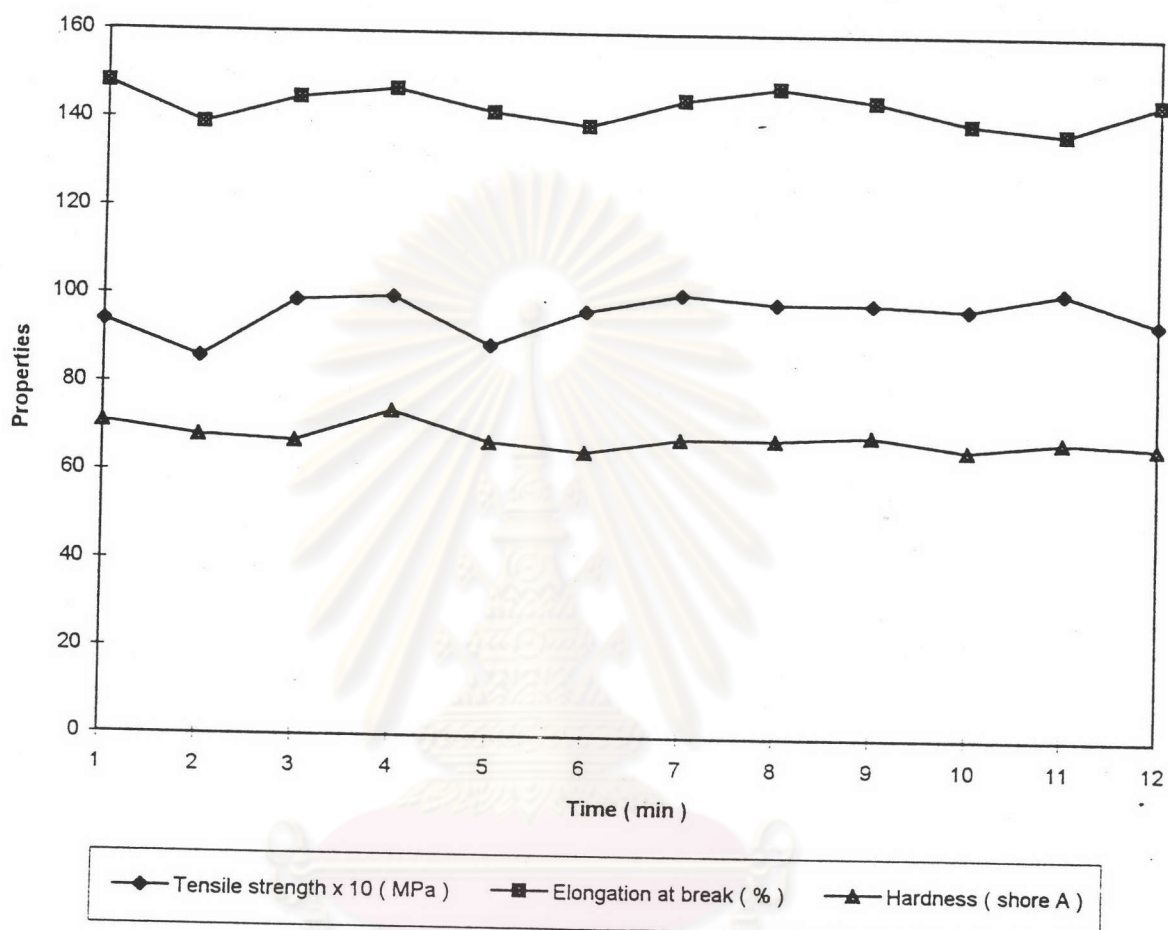


Figure 5.6 The value of mechanical properties of product samples at different collected sample times