CHAPTER 3

CASE STUDY SURVEY

Power cable production had been studied, especially in jacket process. Processing procedure and machine function had been survey after that scrap and down time had been analyzed and machine set up operation also had been checked before doing process analysis.

3.1) Power cable process

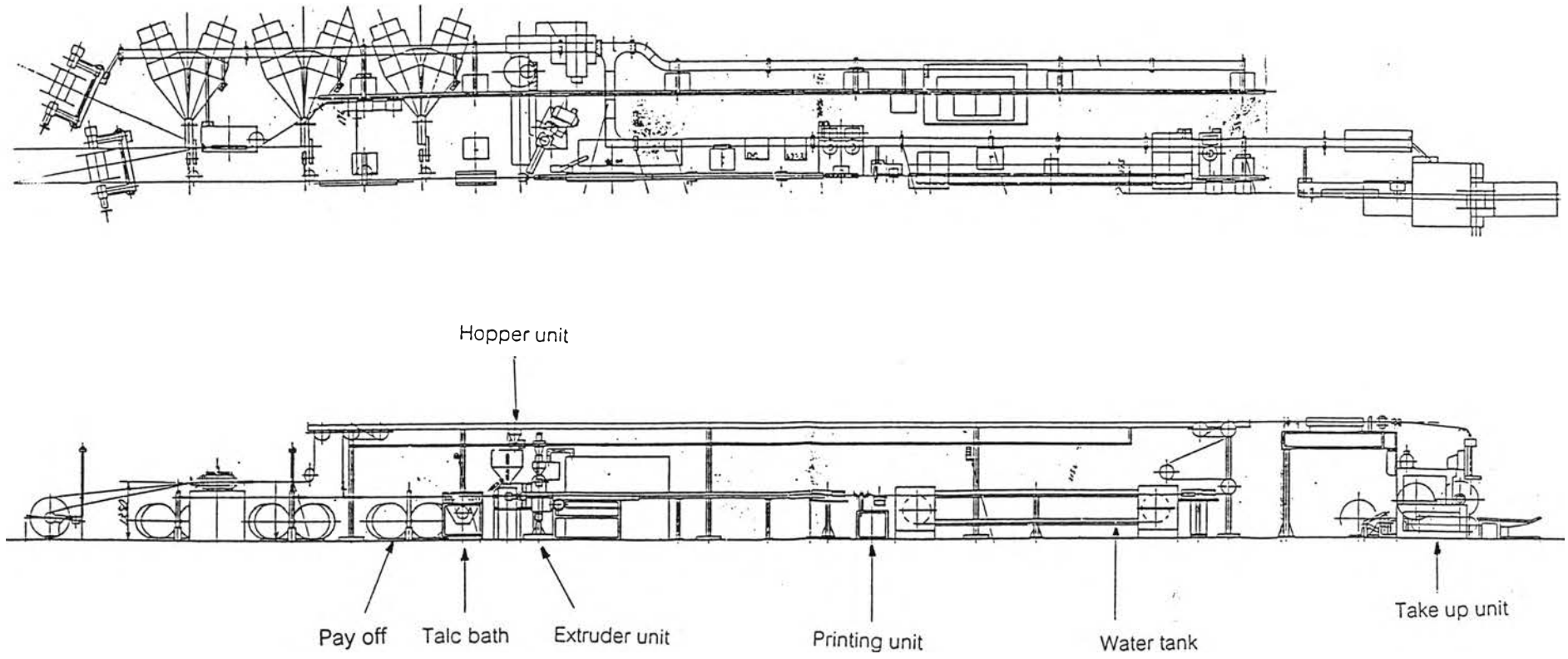
A typical high voltage cable construction usually involves a copper or aluminum conductor over which a semi-conducting strand shield, a natural PVC (it is used for residential low voltage power cable) or PE insulation, after the primary insulation has been manufactured, further processes may be introduced such as a semi-conducting insulation shield, assembly, taping and the application of armoring and or sheaths to the cores. Finally, before the finished product leaves the factory, various quality control tests and inspections must be performed to ensure that the specifications and standards provided for particular application have been met.

In this thesis, only Jacketing process is explained in detail.

3.2) Jacket Process

There are 2 machines which were called Ex-302 and Ex-303 in jacketing process, There are plastics extrusion processes which result from a fundamentally simple technique that consist of heating a plastics material to melt it, forcing the melted material through a shaping die, and subsequently cooling it while holding the shape, and they can be pigmented from clear to opaque in all colors.

Figure 3.1 Jacketing Machine Ex-302 And Ex-303



3.2.1 Jacket machine functional units

The elements of the line are 1. payoff unit, 2. capstan, 3. pre-heater, 4. extruder/die, 5. cooling unit, 6. air wiper, 7. printing unit, 8. second capstan, 9 spark tester, 10. lump detector, 11. puller, 12. take up

3.2.2 Jacket machine functional work

The process starts at payoffs has provided a continuous supply of wire to the downstream machinery. Wire may be pay off from stands form which is uncoiled or from reels either driven or not. The payoff is a two-roll unit. This way, when one reel runs out, the second feed reel can be attached to the trailing section of the first reel to make the process continuous.

The two capstans are tied together for line speed setter with a synchronizing drive arrangement so that the wire is kept under constant tension and taut as it is fed through the die.

To prevent the wire from cooling the plastic melt prematurely, it is run through a pre-heater to bring the wire up to the melt temperature of the plastic.

The extruder's function is to apply the plastic or rubber to the wire. It is analogous to a screw conveyor and the principal working members are the screw and barrel. The revolving screw forces the plastics through a cross-head and coating die. The screw is usually made from an alloy steel with high toughness at the melt temperature for the material.

After the covered wire leaves the die, it is run into a water-cooling tank to set the plastic. The spark tester where a high voltage is placed between the jacket surface and the wire is used to detect the existence of voids or weak spots. The puller is placed between the second capstan and the winder unit to maintain tension on the line and to make the capstan action effective.

The basic function of the take up is to wind wire at constant line speeds. The take up must also be capable of accelerating and decelerating with the line and maintaining proper wire tension during these transition periods. Reel arrangements can vary depending on type of products.

3.3 Existing scrap and down time in Jacketing process

3.3.1 Existing scrap in Jacketing process

Due to the highest of scrap in power cable production at jacket process. In this thesis, it will be concentrated in Jacketing Process to solve high scrap in power cable production.

Table 3.1, 3.2 and 3.3 showed compound and copper scrap analysis of machine Ex-302 and Ex-303 for Power cable in Jacketing Process in February-April,1997. The percentage of scraps of compound and copper were summarized in Figure 3.2 and Figure 3.3.

The cause of scrap which occurred in production line Ex-302 and Ex-303 could be separated into overflow, start adjust, wire break, appearance, printing, diameter and others. The scrap which caused from set up operation were overflow and start adjust.

The start adjust scrap of both machine Ex-302 and Ex-303 were shown the highest percentage of scrap ratio and the over flow scrap of that both machine were also higher than others scrap. So there were concentrated to check.

Overflow scrap had been occurred whenever doing set up operation because operators should overflow compound during that period to the purpose of the replacement with new compound and preventive the compound burn in cross-head cylinder. If set up operations took long times, the overflow scrap was high volume.

Start adjust scrap had been occurred whenever operators adjust the product in order to get the good cable during doing set up operation. So if set up

operations took long times due to need adjustment, the start adjust scrap was high volume.

So if set up operation time was reduced, it might be resulted in reducing of overflow, start adjust scrap and total scrap.

3.3.2 Existing down time in Jacketing process

Due to the highest of down time in power cable production at jacket process, in this thesis, it would be concentrated in Jacketing Process to solve high down time in power cable production.

Table 3.4, 3.5 and 3.6 showed down time analysis of production line Ex-302 and Ex-303 for Power cable in Jacketing Process in February-April,1997. The percentage of scraps of down time analysis were summarized in Figure 3.4 and 3.5 respectively..

The cause of down times which occurred in production line Ex-302 and Ex-303 could be separated into machine problem, product change, quality problem, planning problem, and others. The down time which was caused from set up operation was called product change down time. Because when doing set up operation, machine had been stopped so it was identified to be down time. If set up operations took long times, it was meaning that machine had stopped for long times. It resulted in high down time.

The down time which caused from product change of both machine Ex-302 and Ex-302 were shown the highest percentage in February-April 1997. These product change down time was occurred when set up operation. So it should be reduced set up operation time in order to reduce down time which caused from product change and total of down times.

Table 3.1 : Compound and copper scrap analysis of production line Ex-302 and Ex-303 for Power Cable in Jacketing Process in February'97.

	Scrap on February'97			
Machine	Ex-302		Ex-303	
Causes of scrap	Scrap (kg)	% of scrap	Scrap (kg)	% of scrap
Over flow	696.27	15.16	932.01	26.61
Start Adjust	1,930.81	42.03	1,311.07	37.43
Wire break	671.93	14.63	183.05	5.23
Appearance	89.65	1.95	326.75	9.33
Printing	885.15	19.27	614.55	17.55
Diameter	211.60	4.61	78.60	2.24
Others	108.22	2.35	56.38	1.61
Total	4,593.63	100.00	3502.41	100.00

Table 3.2 : Compound and copper scrap analysis of production line Ex-302 and Ex-303 for Power Cable in Jacketing Process in March'97

	Scrap on March'97			
Machine	Ex-302		Ex-303	
Causes of scrap	Scrap (kg)	% of scrap	Scrap (kg)	% of scrap
Over flow	842.62	20.79	936.95	21.04
Start Adjust	1,702.18	42.01	1,455.34	32.69
Wire break	1,037.93	25.61	1,073.25	24.11
Appearance	6.25	0.15	436.65	9.81
Printing	235.35	5.81	332.45	7.47
Diameter	78.20	1.93	31.55	0.71
Others	149.74	3.70	186.00	4.17
Total	4,052.27	100.00	4,452.19	100.00

Table 3.3 : Compound and copper scrap analysis of production line Ex-302 and Ex-303 for Power Cable in Jacketing Process in April'97

	Scrap on April'97			
Machine	Ex-302		Ex-303	
Causes of scrap	Scrap (kg)	% of scrap	Scrap (kg)	% of scrap
Over flow	579.50	11.13	1,030.00	24.63
Start Adjust	1,326.26	25.47	967.63	23.14
Wire break	859.05	16.50	439.05	10.50
Appearance	139.95	2.69	499.18	11.94
Printing	1,548.46	29.74	883.50	21.12
Diameter	34.95	0.68	61.30	1.45
Others	718.20	13.79	301.75	7.21
Total	5,206.37	100.00	4,182.41	100.00

Table 3.4 : Down Time Analysis of production line Ex-302 and Ex-303 for Power cable in Jacketing Process in February'97

	Down time in February'97			
Machine	Ex-302		Ex-303	
Causes of Down Time	Down Time (hr)	% of down time	Down Time (hr)	% of down time
M/C Problem	30.25	26.63	41.59	30.24
Product change	67.96	59.83	47.75	34.72
Quality	5.76	5.07	5.75	4.18
Planning Problem	6.72	5.92	5.84	15.15
Others	2.90	2.55	1.59	15.71
Total	113.59	100.00	102.52	100.00

Table 3.5 : Down Time Analysis of production line Ex-302 and Ex-303 for Power cable in Jacketing Process in March'97

	Down time in March'97			
Machine	Ex-302		Ex-303	
Causes of Down Time	Down Time (hr)	% of down time	Down Time (hr)	% of down time
M/C Problem	20.07	19.63	31.89	31.45
Product change	32.22	31.51	44.67	44.67
Quality	1.90	1.84	1.90	1.87
Planning Problem	23.63	22.50	16.50	12.65
Others	25.07	24.52	29.48	9.36
Total	102.89	100.00	124.44	100.00

Table 3.6 : Down Time Analysis of production line Ex-302 and Ex-303 for Power cable in Jacketing Process in April'97

	Down time in April'97			
Machine	Ex-302		Ex-303	
Causes of Down Time	Down Time (hr)	% of down time	Down Time (hr)	% of down time
M/C Problem	44.91	28.81	26.59	17.81
Product change	65.02	42.39	66.89	44.81
Quality	5.41	3.53	1.66	1.11
Planning Problem	15.07	9.82	21.16	14.17
Others	22.99	15.45	32.99	22.10
Total	153.40	100.00	149.29	100.00

Figure 3.2 Compound and copper scrap analysis of EX-302 (JK) in Feb'97~Apr'97

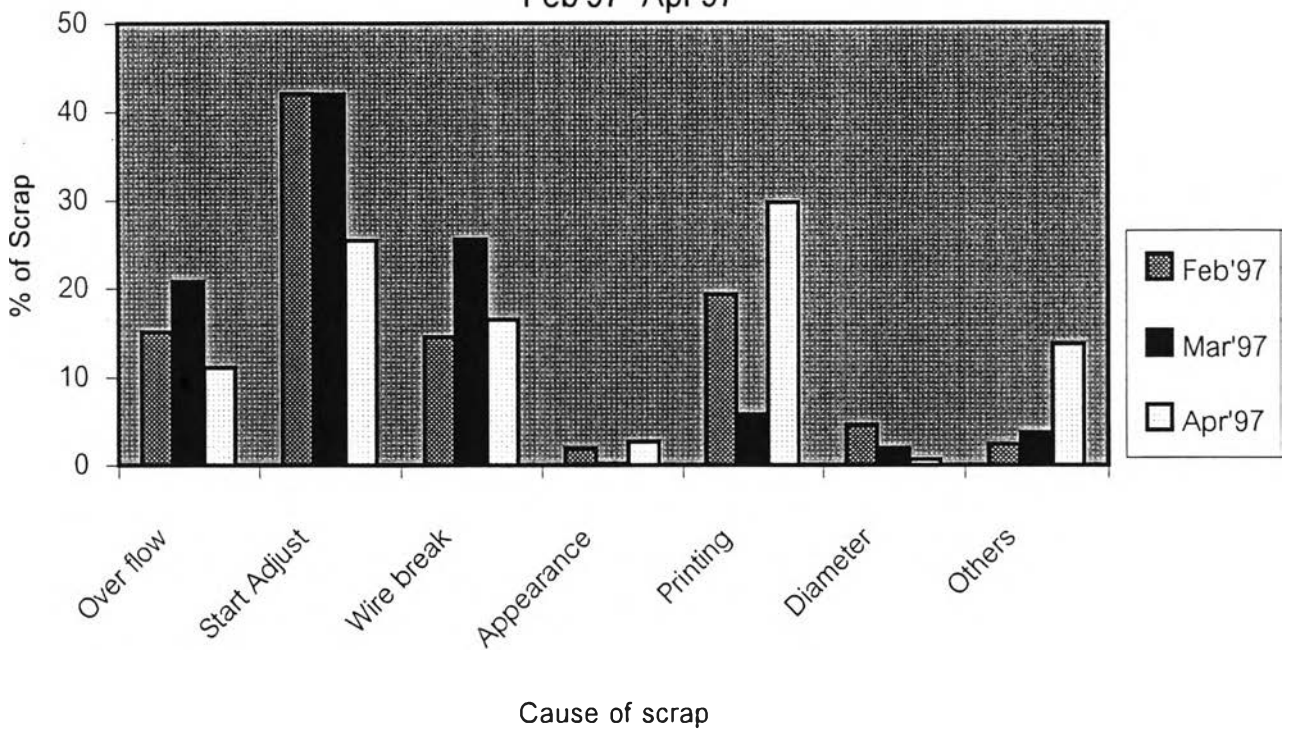


Figure 3.3 Compound and copper scrap analysis of EX-303 (JK) in Feb'97~Apr'97

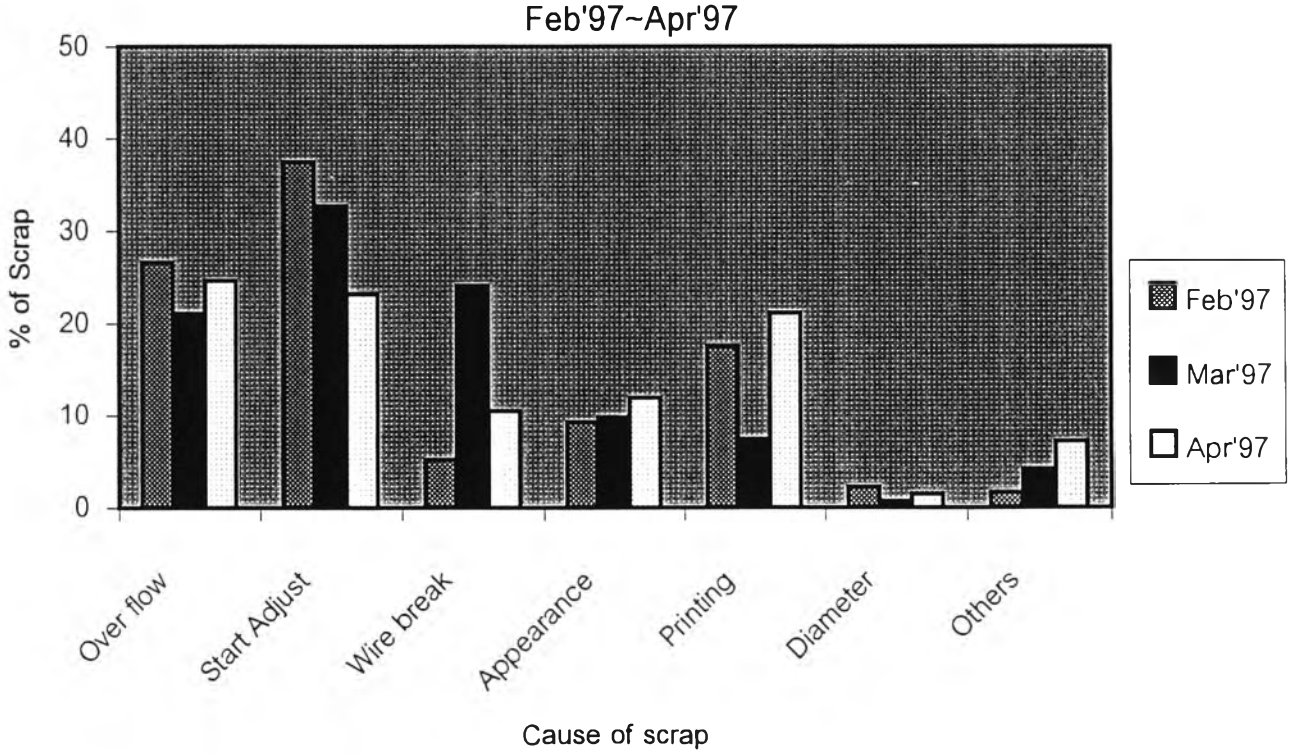


Figure 3.4 Down time analysis of EX-302 (JK) in Feb'97~Apr'97

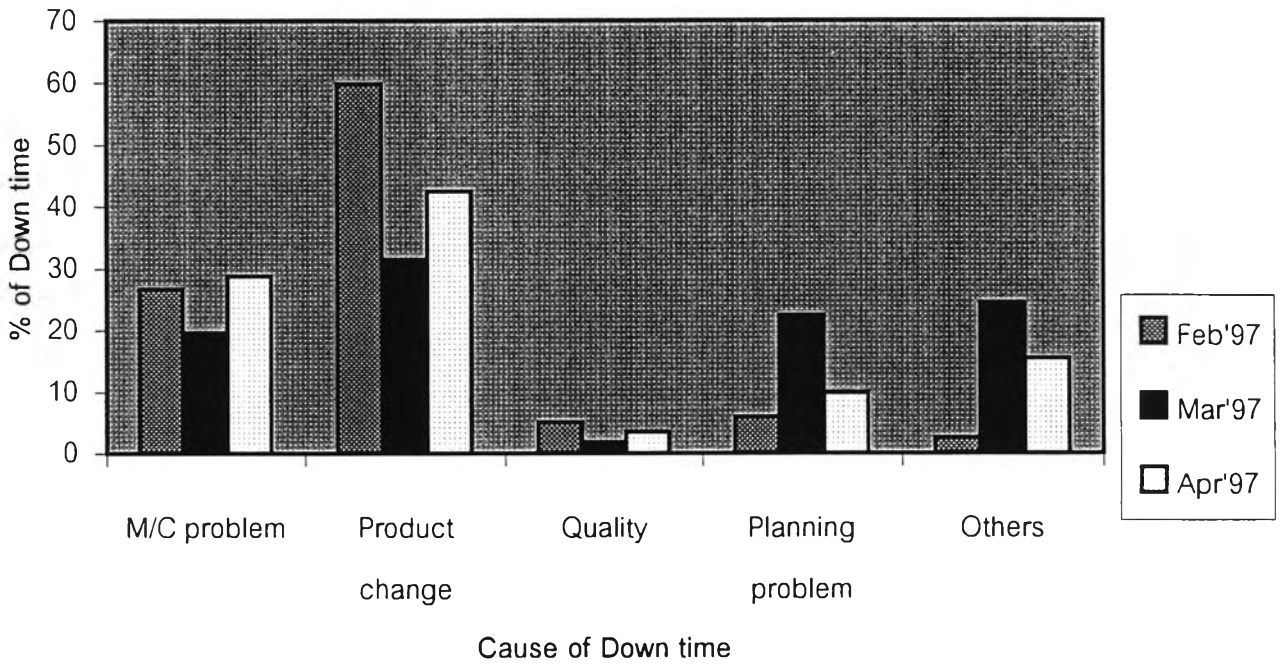
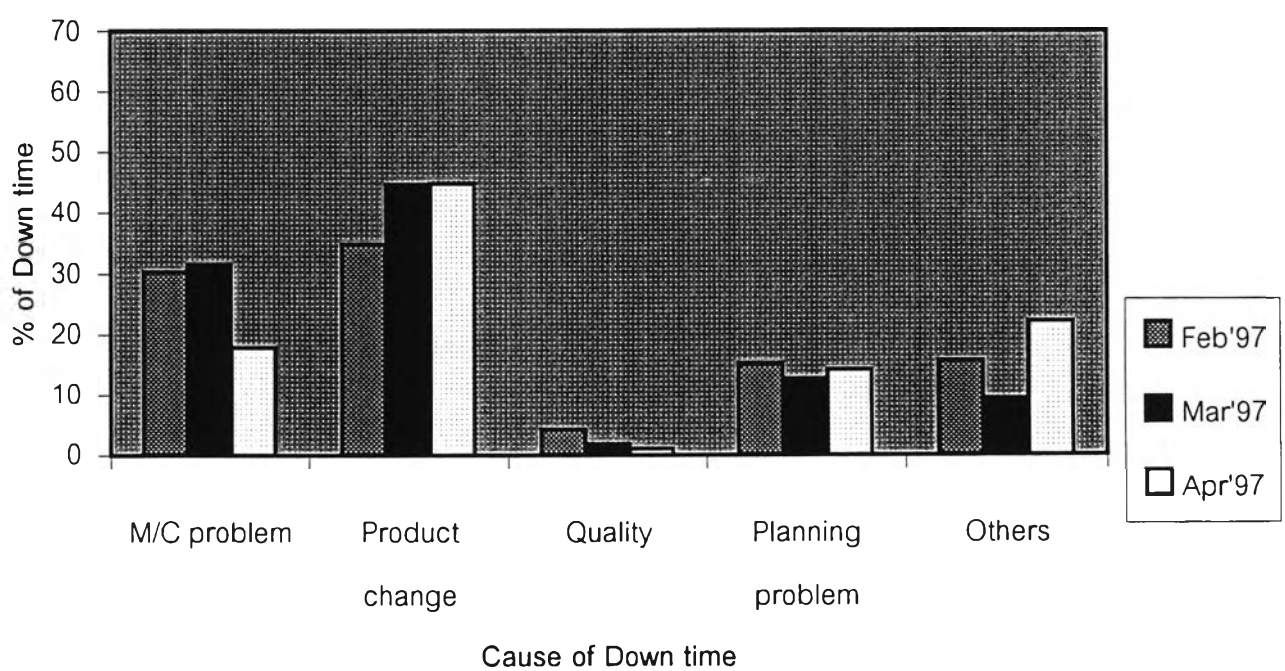


Figure 3.5 Down time analysis of EX-303 (JK) in Feb'97~Apr'97



3.4 Machine set up operation

There are 2 operators who were in chart of each machine being the extruders number of Ex-302 and Ex-303. These 2 operators were main operator and sub operator.

Machine set up operations for main operator and sub operator were summarized in Table 3.7.

Table 3.7 : Machine set up operation of main operator and sub operator

Main Operator	Sub operator
• Clean and set main extruder	• Clean and set printing equipment
• Clean and set sub extruder	• Check and prepare conductor at pay off
• Joint and pass line conduction	• Check and prepare compound at hopper
• Start and adjust product centering	• Counter setting
• Speed up and adjust product centering	• Pass line conductor
• Check product quality	• Check and change take up bobbin
	• Check product quality
	• Input data in check sheet