

An Analysis of Cost Reduction Due to Process Control System on Paper Machine

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The Management of Mysore Paper Mills decided to equip the newsprint paper machine (PM-4) with a sophisticated computer based process control system in the first quarter of 1987. This paper machine was supplied by Beloit Walmsley seven year ago. The deckle of the machine is 6.80 meters, and the designed speed of 750 m/min. The average machine production for several years has been around 75,000 metric tons per year. The raw material for the newsprint has been a variety of fibers, including indigenous CTMP, CSRMP, Chemical wood pulp and imported hard/soft wood pulp. The average machine speed has been 650-670 m/min. The moisture in the paper averaged 5-6% and basis weight averaging 50-51 GSM. Earlier, the machine was equipped with a weight and moisture indicating system supplied by Boyle of U. K.

Like all other mills in India, we at MPM were also very cautious while making a decision whether to go for a process control system or not. There were several doubts in our mind as how significantly this is going to affect our quality and productivity. In recent past, Indian paper market has become more quality conscious and there is more pressure on papermakers. With the introduction of high speed printing presses, customer requirements are becoming more stringent and hard to cope with. Looking ahead in future for even stiffer competition, it was decided to go for a process control system. Process Automation Business, part of Combustion Engineering, USA, was chosen to be the supplier for this Mini-computer based control system. The system was manufactured and assembled in USA. The entire system was installed in 3 weeks time and required an 8 hours machine down time. Automatic controls were optimized in 2 weeks time. Following are the automatic controls implemented on our machine :

- Digital Basis Light Control
- Digital Moisture Control
- Dry Stock Flow Control
- Headbox R/D Control
- Coordinated Speed Change Control
- Cross Machine Caliper Control (At Calender)

MPM being a government mill, we had to justify an investment to the Board of Directors. To see how the system has contributed to our productivity and energy savings, we collected our machine data before the automatic controls were commissioned. Another set of data was collected after the commissioning of controls with process fully on automatic controls. Each time the data was collected for about a period of 10 days to cover a wide spectrum of the machine runnability. The 2 data sets were processed to compare several areas of possible savings.

SAVING DUE TO THE PROCESS CONTROL SYSTEM

INCREASE IN MOISTURE

Before installing the process control system, our moisture average at the reel was 6.0% with a variability of 1.6% (standard deviation of the samples) With process control system, the variability reduced to 0.1% and we could raise the moisture target to 7.4%. We have run the machine at 8.0% moisture for a few days and had to bring down the target to 7.5% due the some temporary problems with our slice, resulting into bad moisture profile. Once we can fix our cross direction profile within a reasonable range, we hope to run 8.0% moisture at the reel on a sustainable basis.

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Percent moisture increase at the reel = 1.4%
 Replacement of fibre by water at the reel = 1.4%
 Fibre savings = 1.4%

ENERGY SAVINGS DUE TO REDUCED STEAM CONSUMPTION!

Our machine is drying capacity limited and any steam saved can be used to dry extra production. With higher moisture at the reel and maintaining it at that level continuously helped us save 10% of the steam. Earlier, our steam consumption per ton of paper was 2.0 tons and with increased moisture, it dropped to 1.8 tons.

Thus savings in terms of steam cost - 10%

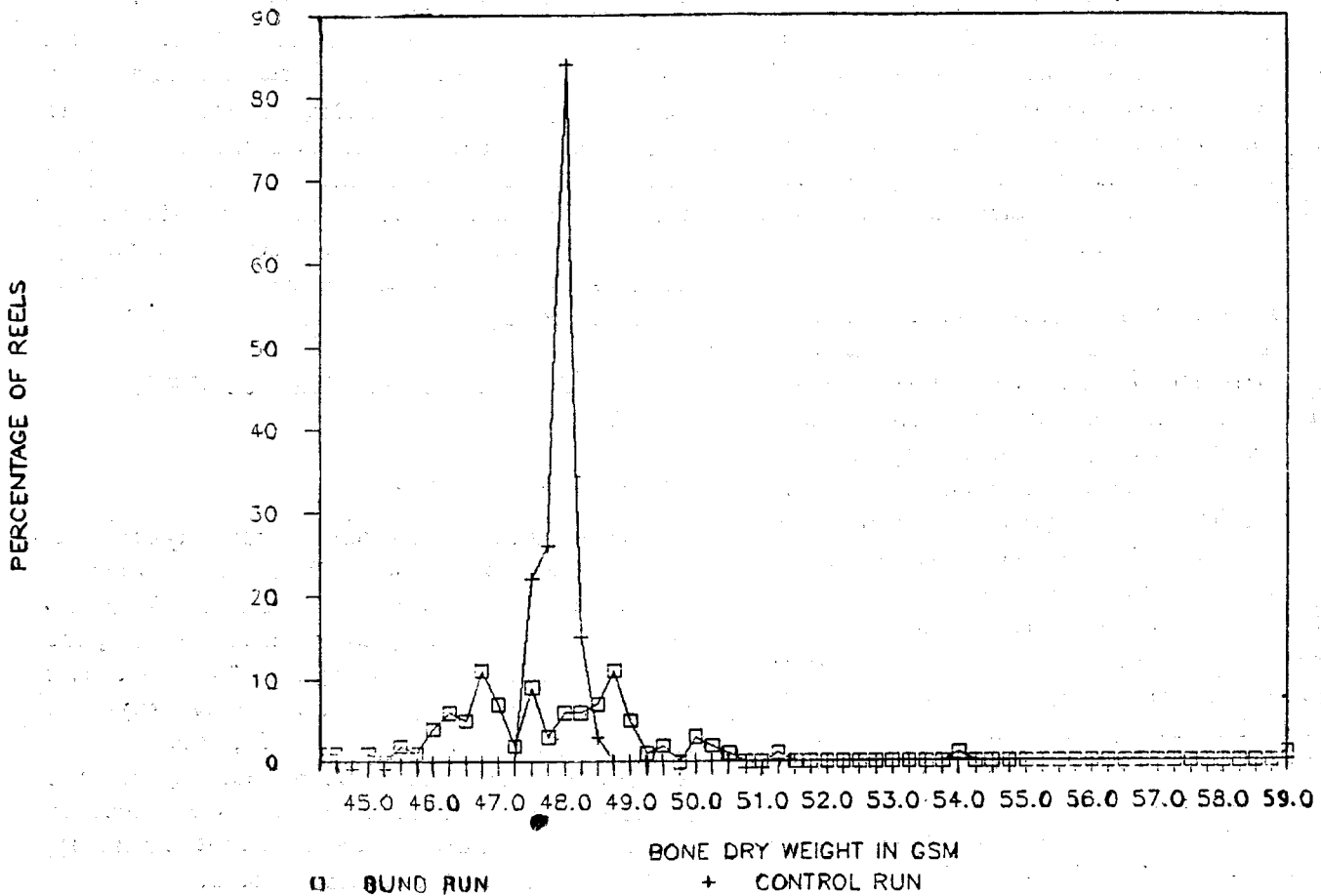
PRODUCTION INCREASE DUE TO INCREASE THROUGHPUT

We observed an increase of 2.22% in the production rate. Before the process control system, our throughput was 13.5 tons/hr as compared to 13.8 tons/hr after. This increase in throughput is due to several factors, increasing the basis weight from 50.8 GSM to 51.7 GSM, increasing the speed marginally, and optimising on trim.

Production increase due to higher throughput = $\frac{15.8 - 13.5}{13.5} \times 100 = 2.22\%$

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REEL TO REEL B.O. WEIGHT DISTRIBUTION



PRODUCTION INCREASE DUE TO REDUCTION IN LOST TIME DUE TO SHEET BREAK

With system controlling our process, we observed a very significant reduction in our lost time due to sheet break. Machine lost time dropped from 8.0% to 3.5%. This means we have 4.5% more machine run time available to produce paper. Although we are yet to realise this benefit as current machine conditions are not normal, we can tap an additional 4.5% production from this extra run time. Conservatively, even if we are able to use half of this extra time to make paper, our future savings will increase as below :

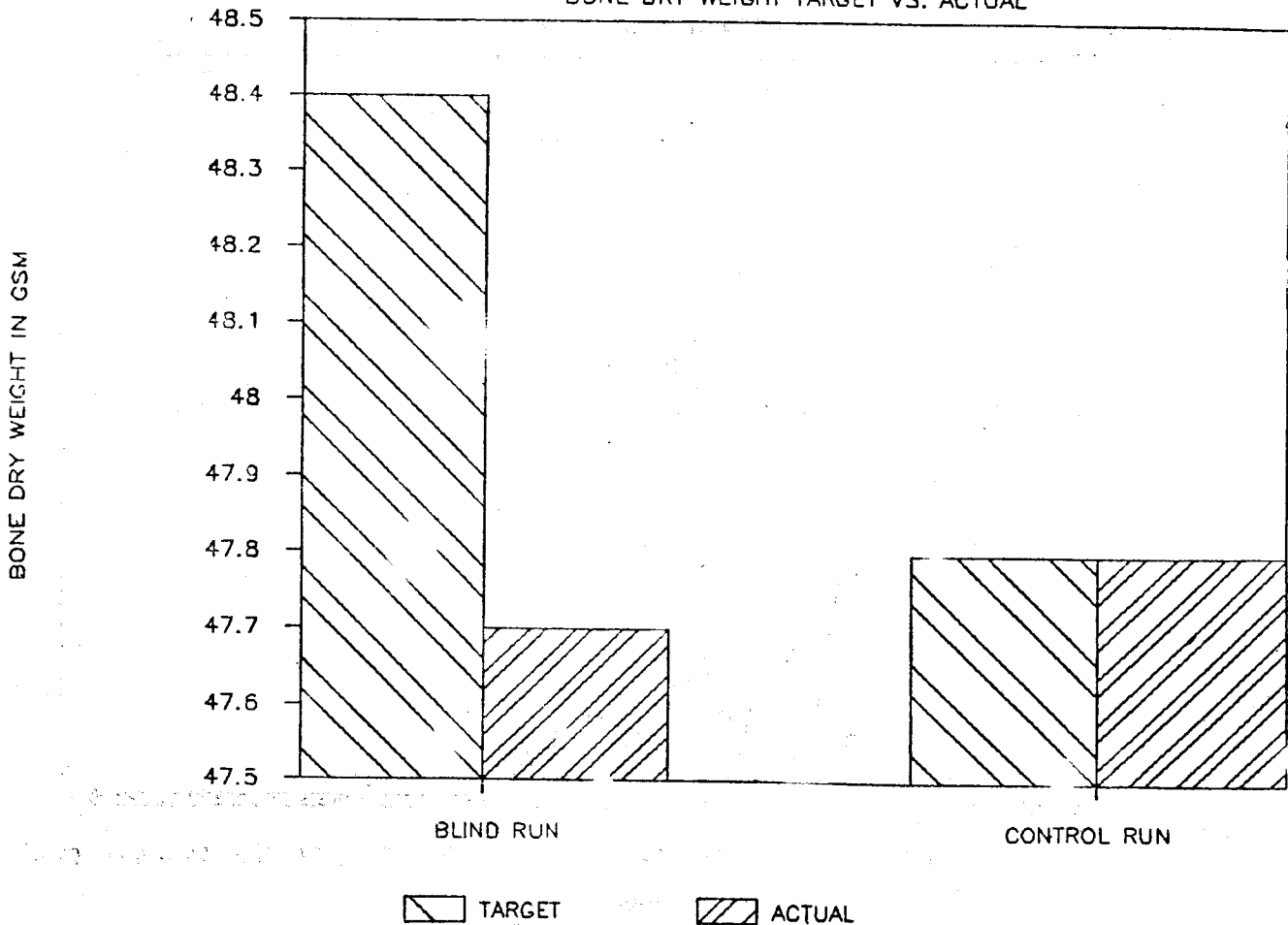
Half of 4.5% extra run time = 2.22%

Increase in production = 2.22%

In addition to the above areas of major tangible benefits, we have noticed improvements in several other areas of machine operation. The time of machine start up has reduced by more than 50% due to the visibility of the process and automatic controls. Total finishing losses have reduced significantly. The reduction in this loss cannot be quantified here as our mode of calculating these losses before & after the process control system were not compatible. With normal machine conditions, we also expect a 4 to 5% increase in machine speed. This speed increase will also give us an extra 4 to 5% production.

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BONE DRY WEIGHT TARGET VS. ACTUAL



PRODUCT QUALITY IMPROVEMENTS DUE TO PROCESS CONTROL SYSTEM.

1. REDUCTION IN DEVIATION FROM TARGET.

For all the 3 parameters, Basis weight, moisture, and bone dry weight, the actual reel average values have no deviation from the target values. The graphical illustrations show the quantified deviations before and after the process control system.

2. REDUCTION IN REEL TO REEL VARIATION.

For basis weight and moisture, we noticed a reduction in reel to reel variation of more than 90% and for bone dry weight 89%. The variability was

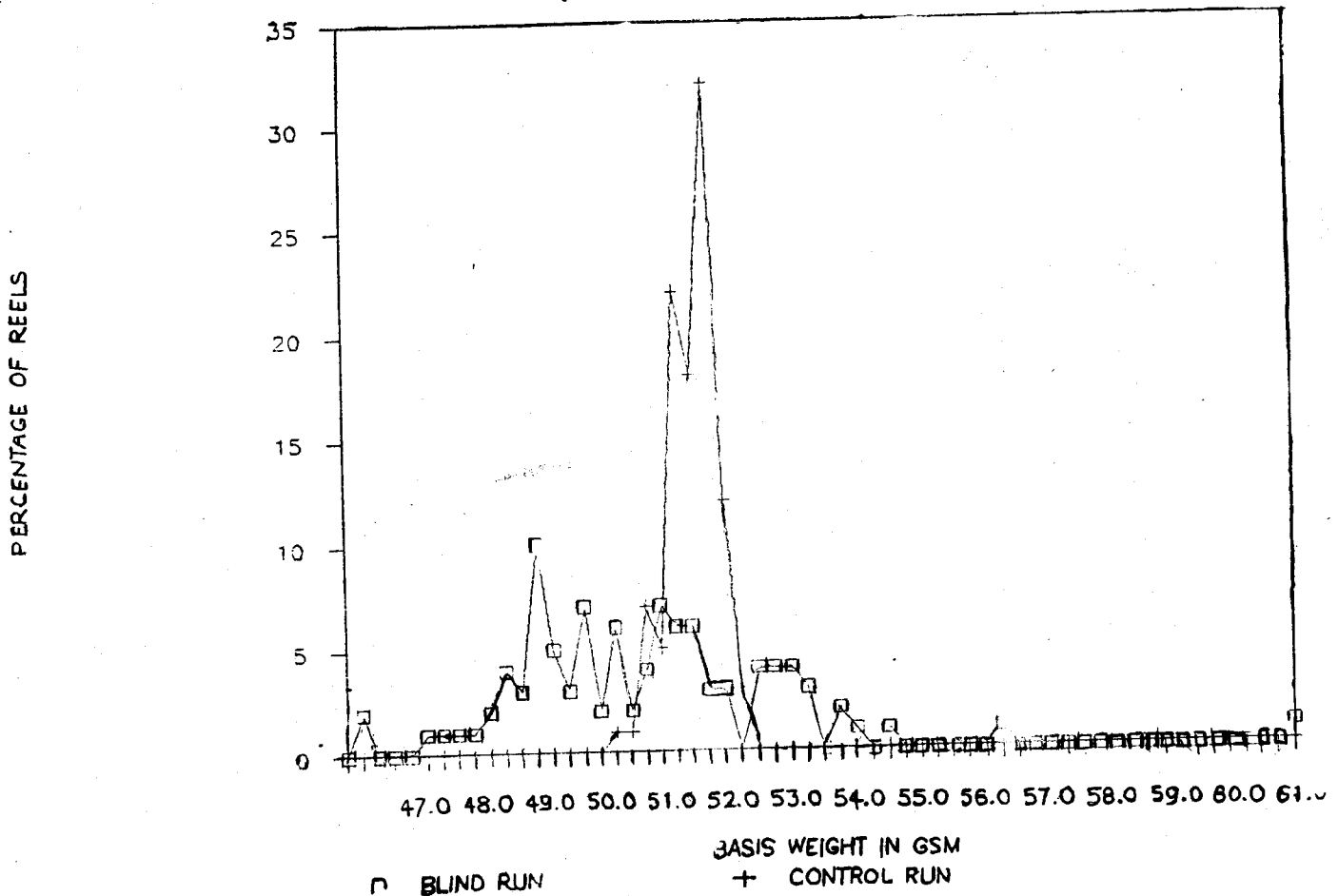
measured in terms of standard deviation of the samples as how far apart the actual reel average stayed from the target. Graphical illustrations show the distribution of all the samples before and after the process control system.

3. REDUCTION IN CROSS MACHINE CALIPER VARIATION.

On our newsprint machine, good roll building has always been our problem. With cross machine caliper control, we have been able to make almost flat rolls. The reduction in the CD variability (measured in 2 x standard deviation), has been more than 50%. Average variability before was 5 to 6 microns as compared

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REEL TO REEL BASIS WEIGHT DISTRIBUTION



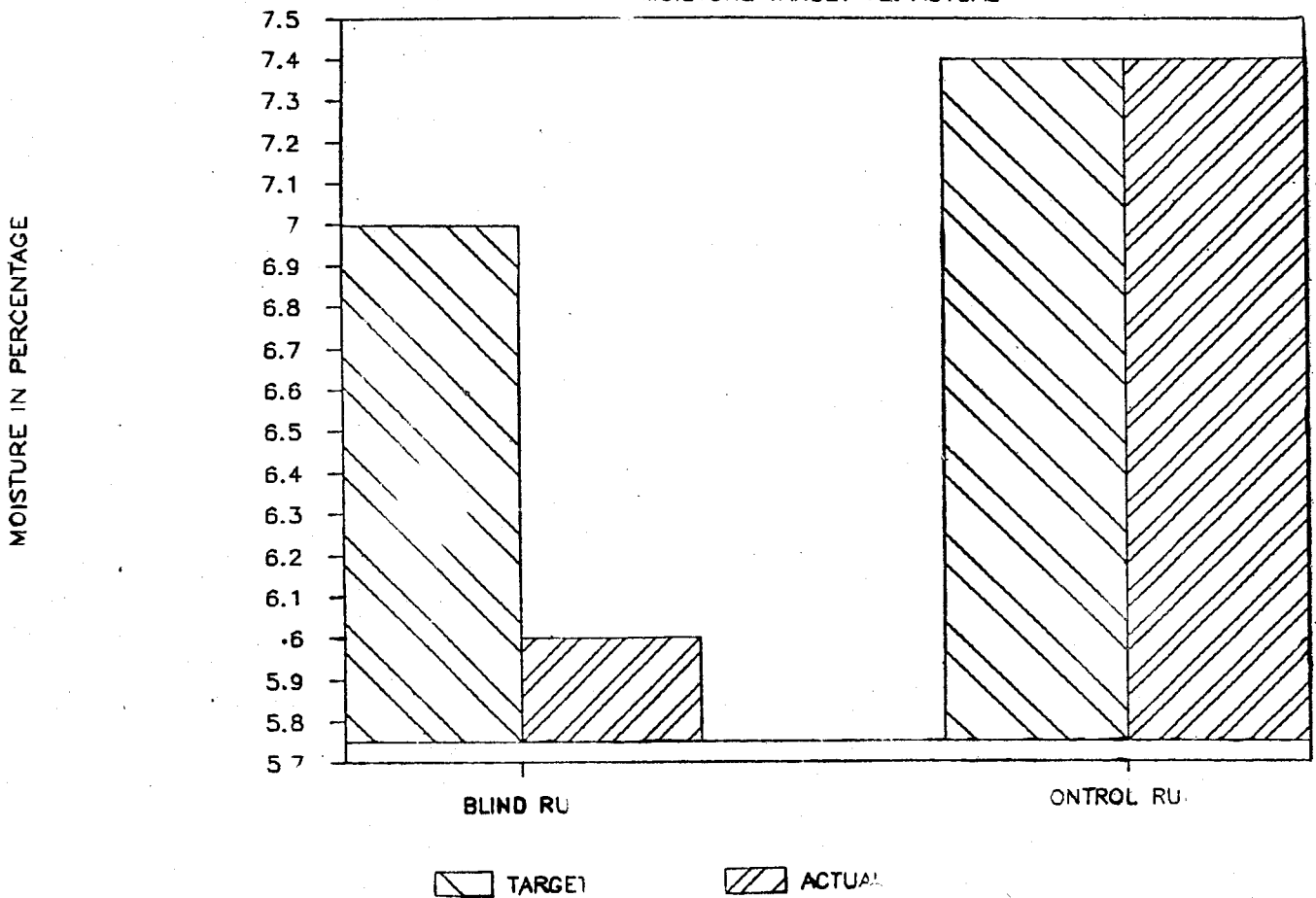
to 2 to 2.5 microns after the process control system. With good roll build up, the rewinder speed has gone up by 25%.

To summarise the contribution of process control system on our machine, we can gladly share th t

immediately after the process control system commissioning, we made a record production in the month of February. Currently we are using this system only for controlling the process parameters. We are sure as we go along the learning curve, our production personnel can use it more for machine troubleshooting and maximise the production.

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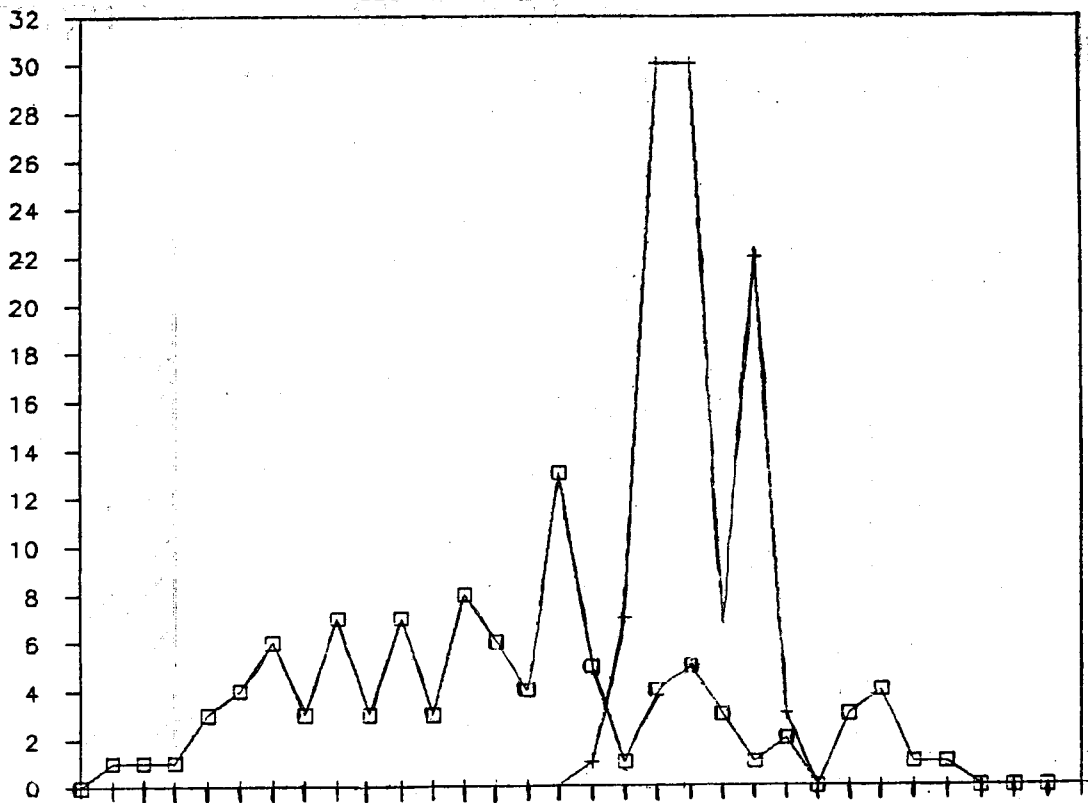
MOISTURE TARGET VS. ACTUAL



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REEL TO REEL MOISTURE DISTRIBUTION

PERCENTAGE OF REELS



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BASIS WEIGHT TARGET VS. ACTUAL

