Crop Processing Adjustment for Corn Silage

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A properly adjusted forage harvester crop processor will break the corn kernels and rid the silage of large cob pieces. The primary adjustment is the clearance between the processing rolls which should be sufficiently small to break nearly all the kernels but not so small that it creates excessive power requirements; a very small clearance causes excessive wear on the processing rolls.

Since the crop processor adds to the harvester power requirement and may reduce harvesting capacity, some operators attempt to adjust the roll clearance as large as possible while maintaining quality based on kernel breakage. Recent studies indicate there is an adjustment which meets both goals.

Wisconsin studies evaluated the impact of crop processing roll clearance on silage characteristics and energy requirements. Jirovec et al,1999, conducted studies over two seasons and at a crop maturity, ranging from 1/3-3/4 milk line. Particle length, kernel breakage, cob breakage and energy requirements were evaluated.

In a 1997 study, they obtained 100% kernel breakage with a theoretical length of cut (TLC) of 3/4" and a roll clearance of 0.04" (Table 1). At a clearance of 0.12" the kernel breakage was 91%. These are significantly lower than the non-processed silage where the kernel breakage was 63 and 50% respectively for 3/8 and 3/4" TLC. The mean particle length of the corn silage was reduced by the crop processor but not below the results obtained from the 3/8" TLC and no processing.

Table 1. 1997 Processor results for corn silage harvested at 1/3 and 1.2 milk line, Jirovec et al, 1999.

	Non-Processed		Processed	
Theoretical length of cut (in.)	3/8	3/4	3/4	3/4
Roll Spacing (in.)	-	-	0.04	0.12
Mean Particle Length (in.)	0.41	0.64	0.46	0.53
Kernel Breakage (%)	63	50	100	91

The energy requirements were calculated from data collected from torque and speed sensors on the forage harvester and are in terms of horsepower-hours per ton (energy per ton). The chopper fuel requirements were estimated by using American Society of Agricultural Engineers recommendations (did not include the tractive power).

In 1998, they evaluated silage at three maturities (1/3, 1/2, and 3/4") and added a roll clearance of 0.20"; cob breakage and power requirements were also evaluated. The results indicated slightly improved kernel breakage, partially attributed to the 3/4 milk line treatment that was added. As the crop matures, kernel breakage improves. The cob breakage was complete for all three roll clearance settings. For the non-processed setting, some whole cob pieces remained.

Table 2. 1998 Processor results for corn silage harvested at 1/3, 1/2 and 3/4 milk line, Jirovec et al, 1999.

	Non-Processed		Processed		
Theoretical length of cut (in.)	3/8	3/4	3/4	3/4	3/4
Roll Spacing (in.)	-	-	0.04	0.12	0.20
Mean Particle Length (in.)	0.45	0.77	0.47	0.49	0.57
Kernel Breakage (%)	67	58	100	96	88
Whole Cobb (%)	96	92	100	100	100

Feedrate through the forage harvester ranged from 35.6-39.0 tons per hour (Table 3); no significant differences were found among the operating conditions. The processor increased the energy requirement for the chopper. The energy requirement at the 0.04" clearance (2.99) was significantly higher than the 0.08" (2.76) and 0.12" (2.70) clearances. The difference between 0.8 and 0.12" was not significant.

Table 3. Energy and fuel requirements for the 1998 studies, Jirovec, et al, 1999.

	Non-Processed		Processed		
Theoretical length of cut (in.)	3/8	3/4	3/4	3/4	3/4
Roll Spacing (in.)	-	-	0.04	0.12	0.20
Feedrate (tons/hr)	37.6	38.5	35.6	38.8	39.0
Energy Req't (Hp-hr/t)	2.69	2.14	2.99	2.76	2.70
Fuel Requirement (gal/ton)	0.222	0.176	0.247	0.228	0.223

The fuel consumption trends are the same as the energy requirements for the chopper. The 0.04" roll clearance had the highest fuel requirement, 0.019 gallons per ton more than the 0.12" clearance (Table 3). The difference is estimated at 0.7 gallon per hour. Again the difference between 0.12 and 0.20" clearance was not significant.

In summary, recommended roll clearance should be between 0.04 and 0.12" with TLC of 3/4". This setting will break all the cob pieces and the broken kernels will exceed 90%. Adjusting the clearance closer to 0.12" will not create excessive power and fuel requirement.