8-25

# Effect of Peripheral Velocity Difference Ratio on the Performance of Rubber Roll Husker

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## I Introduction

The difference in speed between the rubber rolls results in a shearing action on the rice grain as it passes between the rolls (Yamashita et al 1990, FA, 1995). The shearing force is thus dependent on the relative velocity between the rolls and the normal force. The normal force is generally determined by the clearance between the rolls. Since energy is a very significant part of the rubber husker performance, consideration of its influencing factors is vital. The work done $\Delta w$ [kJ/kg] by the rolls during husking is generally expressed as shown below;

$$\Delta w = 2\mu p \phi l_c \qquad \text{[kJ/kg]} \qquad (1)$$

where $\mu$ is the coefficient of friction, $p$ [kN/kg] is the normal force, $l_c$ [m] is the contact length and $\phi$ is the peripheral velocity difference ratio (PVDR) given by;

$$\phi = \frac{\pi(DN - dn)}{v_g} \qquad (2)$$

where $D$, $N$, $d$, $n$, are the roll diameter [m] and speed [rpm] for the main and auxiliary rolls and $v_g$ [m/s] is the grain velocity. From previous experiments, the grain velocity was found to be close to that of the auxiliary roll. Thus for rolls of equal diameter, $\phi$ can be expressed as;

$$\phi = \frac{(N - n)}{n} \qquad (3)$$

## II Methodology

Three different varieties of rice, Akitakomachi (short grain), Delta (Long grain) and L201 (long grain) harvested at Iwate University farm in 1999 were husked using an experimental rubber roll husker (SATAKE - THU) with equal roll diameters of 0.10 m and rated PVDR of 0.83. The PVDR between the rolls was varied from 0 to 8.4. The auxiliary roll speed was varied from 391 rpm to 1295 rpm and the main roll speed from 1295 rpm to 3391 rpm. The effect of PVDR on the huskers' performance was then evaluated. Husking was carried out at the optimal roll clearance of 1.8 mm for Akitakomachi, 1.5 mm for Delta and 1.3 mm for L201. The husked ratio, broken ratio and cracked ratio of the grain were considered in the performance evaluation.

## III Results

The husked ratio for the three varieties of rice generally increased with the increase of the PVDR attaining a peak before starting to decrease (Figure 1). Further increase resulted in unstable variation in husked ratio. The PVDR peak values were 0.71 for Akitakomachi, 0.46 for Delta and 1.06 for L201 at their optimal roll clearance. Their corresponding husked ratios were 97%, 98% and 97% respectively. The PVDR for the short grain rice was close to the rated value. A similar trend was observed for the broken ratio (Figure 2). However, after the decrease the broken ratio continued to increase again. The trend for the cracked ratio was similar to that of the husked ratio (Figure 3). However, the cracked ratio tended to approach a constant value.

## IV Conclusion

The optimal peripheral velocity difference ratio is grain variety dependent and it significantly affects the roll huskers' performance. However, optimal PVDR value based on the husked ratio also results in high grain damage. Thus further tests are to be carried out to harmonize the optimal PVDR and the grain damage.

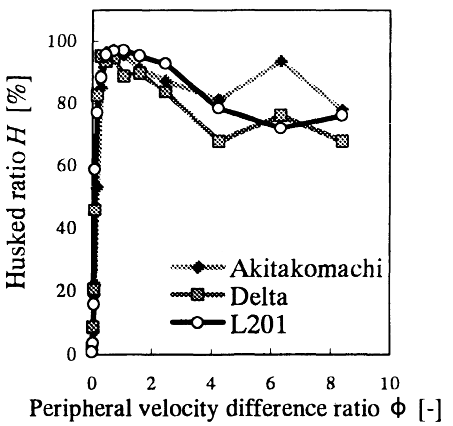


Fig. 1 Husked ratio vs. peripheral velocity difference ratio

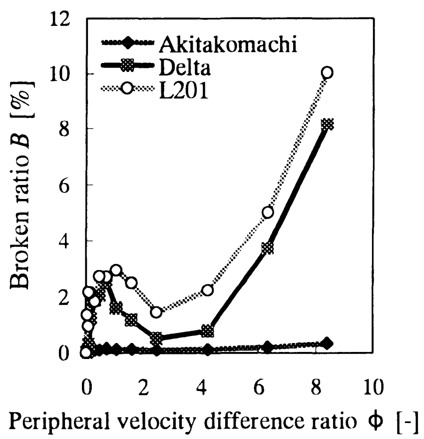


Fig. 2 Broken ratio vs. peripheral velocity difference ratio

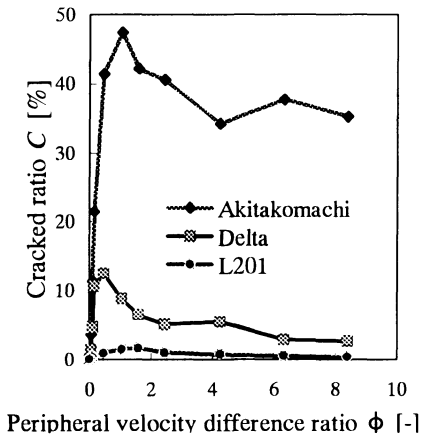


Fig. 3 Cracked ratio vs. peripheral velocity difference ratio