IMPACT OF DIFFERENT ROLL SIZES ON ROLLER COMPACTOR GRANULATIONS

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PURPOSE

To determine if constant linear roll face speed and compaction force/unit length (across roll width) would yield similar granulations from two different sized roller compactor rolls.

METHODS

Formulation used in this study is listed in Table 1. The lactose and microcrystalline cellulose (MCC) was blended in a V-blender for 3 minutes; the magnesium stearate was added to the mixer and blended for an additional 3 minutes.

Resulting blend was then compacted on two different roller compactors (TF-156 and TFC-220). Rolls used are shown in Equipment section. Compaction force was tested at two levels: 7.0 and 14.0 kilonewton/cm. Compacts were generated with four different roll speeds (188.5; 377.0; 565.5; and 754.0 cm/min) and a constant screw to roll rpm ratio of 3:1.

Ribbon thickness was measured. Compacted ribbons were milled through a 14 mesh screen in a rotary granulator. After milling, the granulations were sieved to determine arithmetic mean diameter (D_{50}) and measured for bulk density.

Table 1 – Formulation Characteristics

Ingredients/Characteristic	Value
MCC, PH-101	20.0%
Lactose, 312	79.3%
Magnesium Stearate	0.3%
Mean Particle Size, D_{50} (µm)	92.0
Bulk Density (g/cc)	0.470

Table 2 – Compaction Process Parameters

Process Parameters	TFC-220	TF-156
Unit Roll Force		
7.0 kN/cm	3000 pounds	3.5 tons
14.0 kN/cm	6000 pounds	6.9 tons
Roll Speeds		
188.5 cm/min	3 rpm	4 rpm
377.0 cm/min	6 rpm	8 rpm
565.5 cm/min	9 rpm	12 rpm
754.0 cm/min	12 rpm	16 rpm
Screw to Roll RPM Ratio	3:1	3:1

EQUIPMENT

Roll Comparison

Screw Comparison

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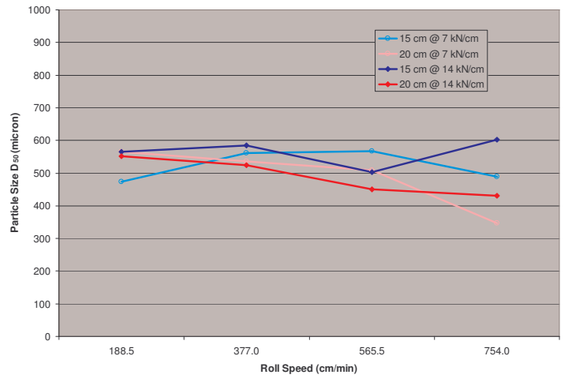
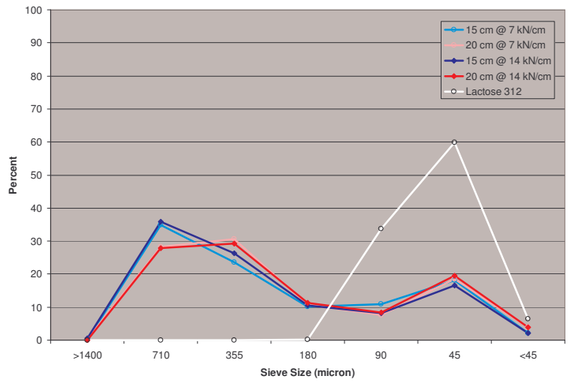
RESULTS

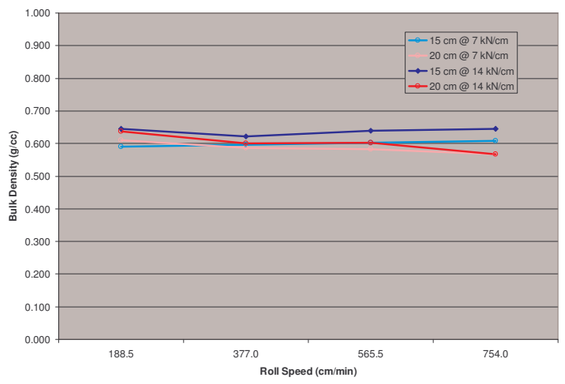
Mean Particle Size at Various Roll Speeds



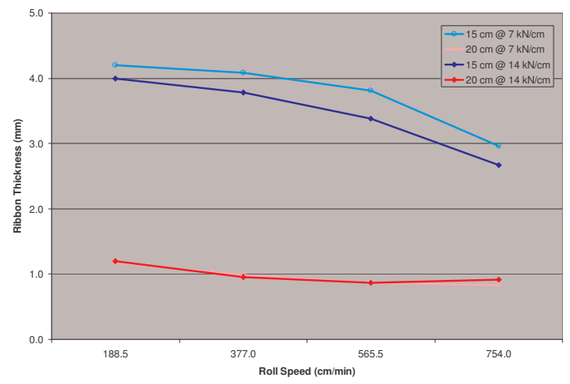
Particle Size Distribution at 377 cm/min



Bulk Density at Various Roll Speeds



Ribbon Thickness at Various Roll Speeds



CONCLUSIONS

For low to mid-range roll speeds, constant linear roll face speed and constant compaction force/unit length appears to yield similar granulations in terms of mean particle size (D_{50}) and bulk density. Increasing the speed of the rolls (reducing the dwell time) in this range appears to cause a downward shift in the ribbon thickness, D_{50}, and bulk density. The reduction in D_{50} and bulk density is probably a result of less time being allowed for bonds to form between particles. Thickness of the ribbon does not seem to impact the characteristics of the granulation for a constant roll speed and compaction force/unit length.

The difference in roll and screw design between the two machines do appear to cause a shift in granulation characteristics at high roll speeds. This is thought to be a result of a change in slippage of the powder at the roll face and a corresponding change in the pre-compression applied by the screw.