

# ZERO-WASTE APPROACH FOR GREENHOUSE FRUIT VEGETABLES

T. Van Laere, P. Knockaert, J.S.D. Coene, S. De Meester

Laboratory for Circular Process Engineering ( Department of Green Chemistry and Technology, Ghent University )

## Introduction

After harvesting greenhouse vegetables, the greenhouse foliage, including ropes and clips contains both biomass and plastics, making waste disposal difficult. Consequently, separation of the biomass from the plastics is an important part in the further recycling of organic material and possibly the plastics. It is therefore necessary to consider which separation techniques can be used to further separate the different materials. In this work both wet and dry separation techniques were tested experimentally for tomato and pepper waste.



## Sieves

- Separation by particle size
- 2 sieves → 5.6 mm & 2 mm



Results:

- Rope tangling
- > 97% of ropes in upper fraction (> 5.6 mm)
- Clips present in smallest fraction (< 2 mm)



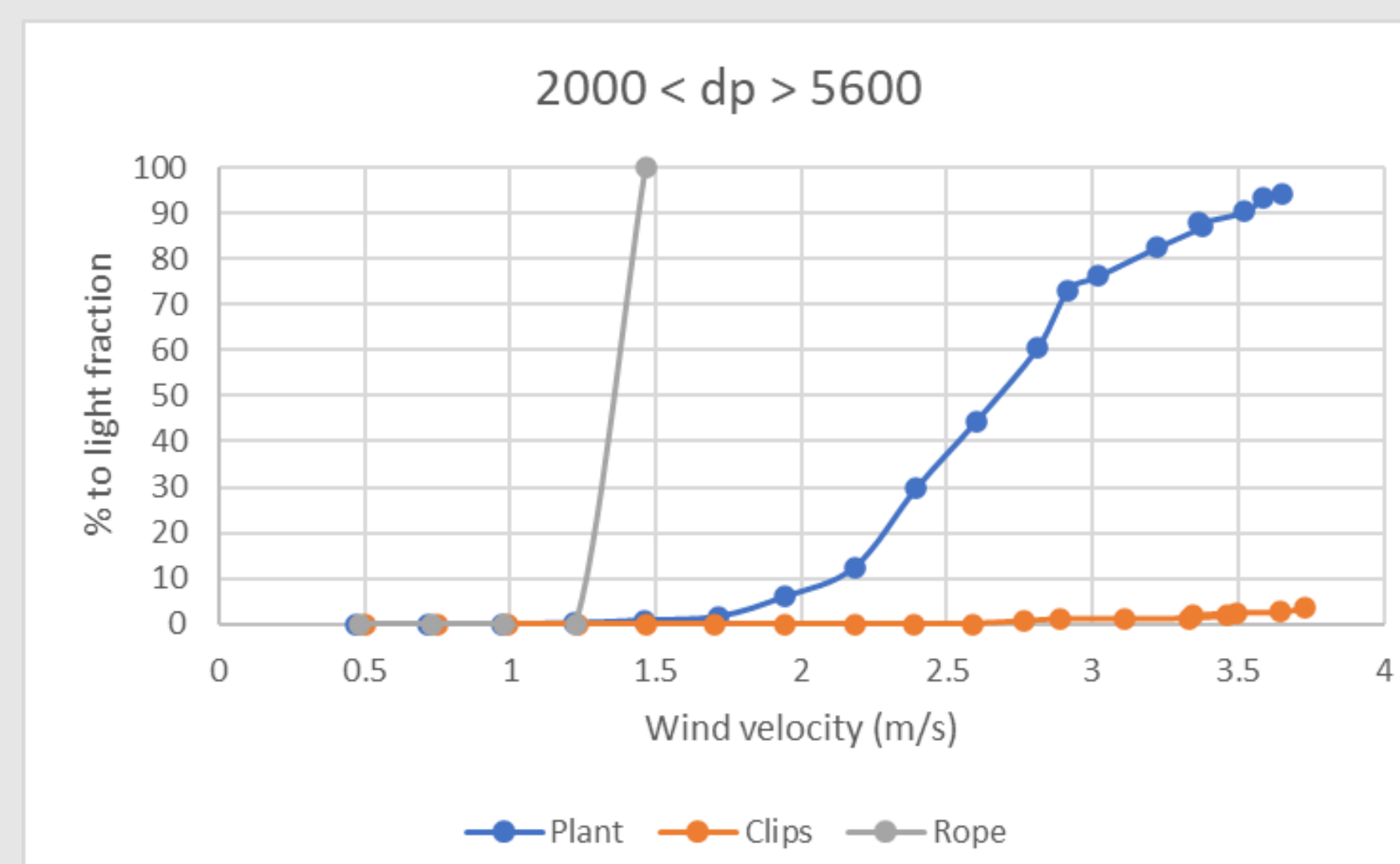
## Windsifter

- Separation by difference in absorption of kinetic energy
- Configuration 1 is used



Results:

- 3 different materials
- Rope → low wind velocity
- Biomass → moderate wind velocity
- Clip → /



## Pulp formation

- Separation by shrinking biomass
- Kraft process (P. Bajpai, 2018)
- Chemical pulping at low temperature (M. Akgul and H. Kirci, 2009) (P. Musekiwa et al., 2009)



Results

- Kraft process
- 2 separate fractions
- Chemical pulping at low temperature
- /



## Conclusion

### 1) Drum sieve + windsifter

- Advantages
  - Biomass fraction exists of > 97% biomass
  - Material can be used for composting
- Disadvantages
  - Rope fraction with biomass can not be recycled
  - Manual clip removal

### 2) Pulping

- Advantages
  - 2 separate fractions
  - Rope → pyrolysis
  - Pulp → e.g. cardboard
- Disadvantages
  - Hard conditions
  - Risk of PP degradation



## References

- P. Bajpai, Biermann's Handbook of Pulp and Paper (Third Edition), Third Edit. Elsevier, 2018, doi:10.1016/B978-0-12-814240-0.00001-X.
- M. Akgul and H. Kirci, 'An environmentally friendly organosolv (ethanol-water) pulping of poplar wood', J Environ Biol, vol. 30, no. 5, pp. 735-740, 2009.
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## Contact

Tine.vanlaere@ugent.be  
www.lcpe.ugent.be

Universiteit Gent

@ugent

Ghent University