



Technical Feasibility Analysis of Zero Waste for Paper and Plastic

Deepak Kumar Sharma¹

William Brandes

Dr. Marco J Castaldi¹

¹ Chemical Engineering Department, The City College of New York , New York, USA

The City College
of New York

INTRODUCTION

Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them. Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health. It has never been achieved by a modern state. This poster assesses information on technical obstacles to achieving zero waste. Paper and plastic waste streams, significant contributors to our solid waste management problems, are examined from this perspective.

RECYCLING

Recycling of different waste streams varies along different communities. Below individual streams have been selected from different communities and it can be observed how much waste remains even after recycling.

ROADBLOCKS

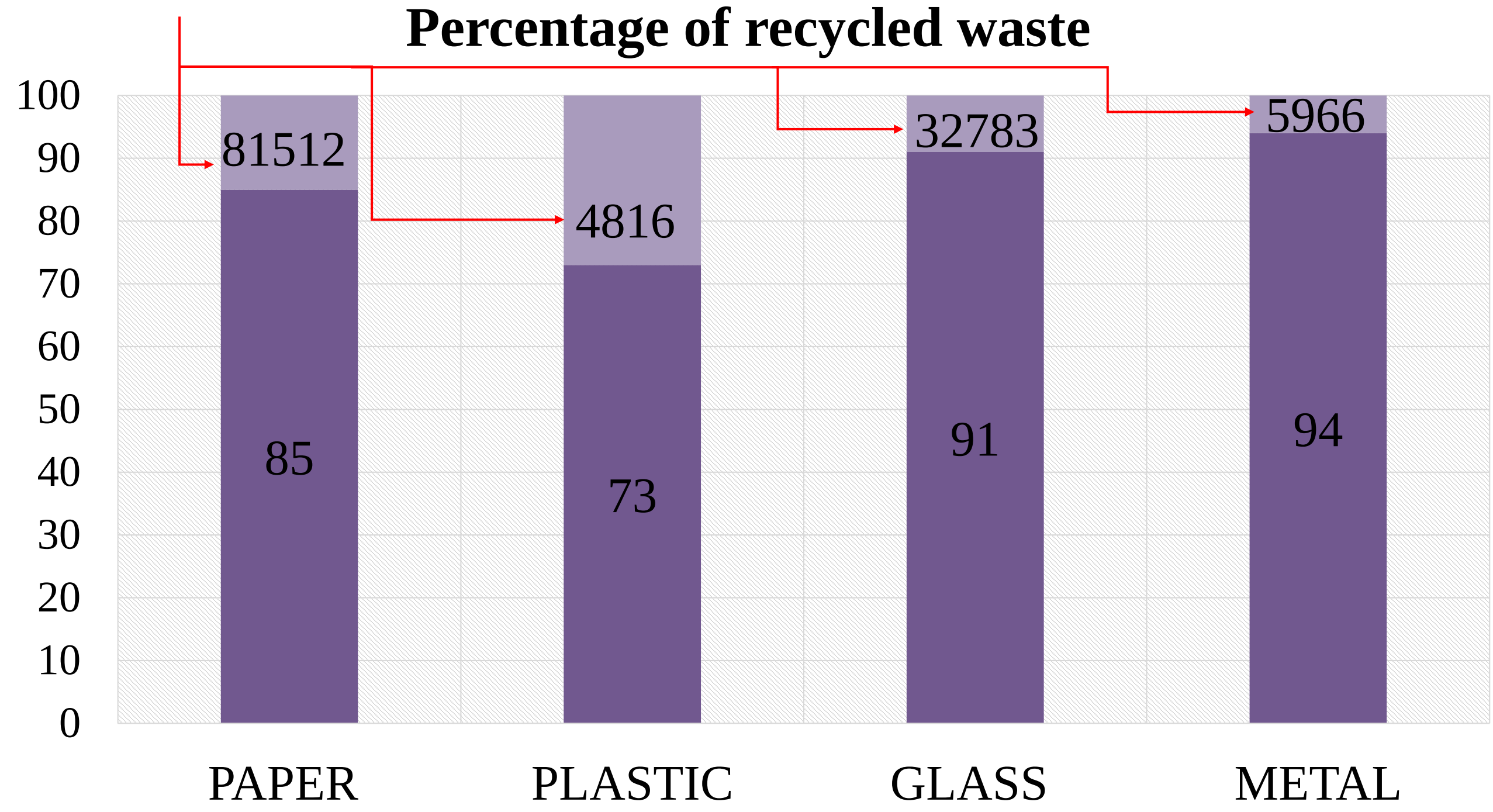


Figure -1: Recycling % of different streams.

LIMITATIONS IN PAPER RECYCLING

- Low quality feed and aged paper waste deteriorates the quality of paper produced.
- Repeated recycling causes loss in tensile strength.
- Enzyme treatment done to improve fiber quality must be monitored closely as wrong loading of enzyme may also cause change in tensile strength.
- Paper waste also includes impurities such as fillers inks adhesives etc. which during recycling form stickies which decreases the web strength and paper brightness.

Recycled	0	1	2	4
Breaking length (km)	5.29	4.48	4.36	3.93

Table -1: Sulphite pulp properties [1] [2] (Breaking length here is associated with webbing strength)

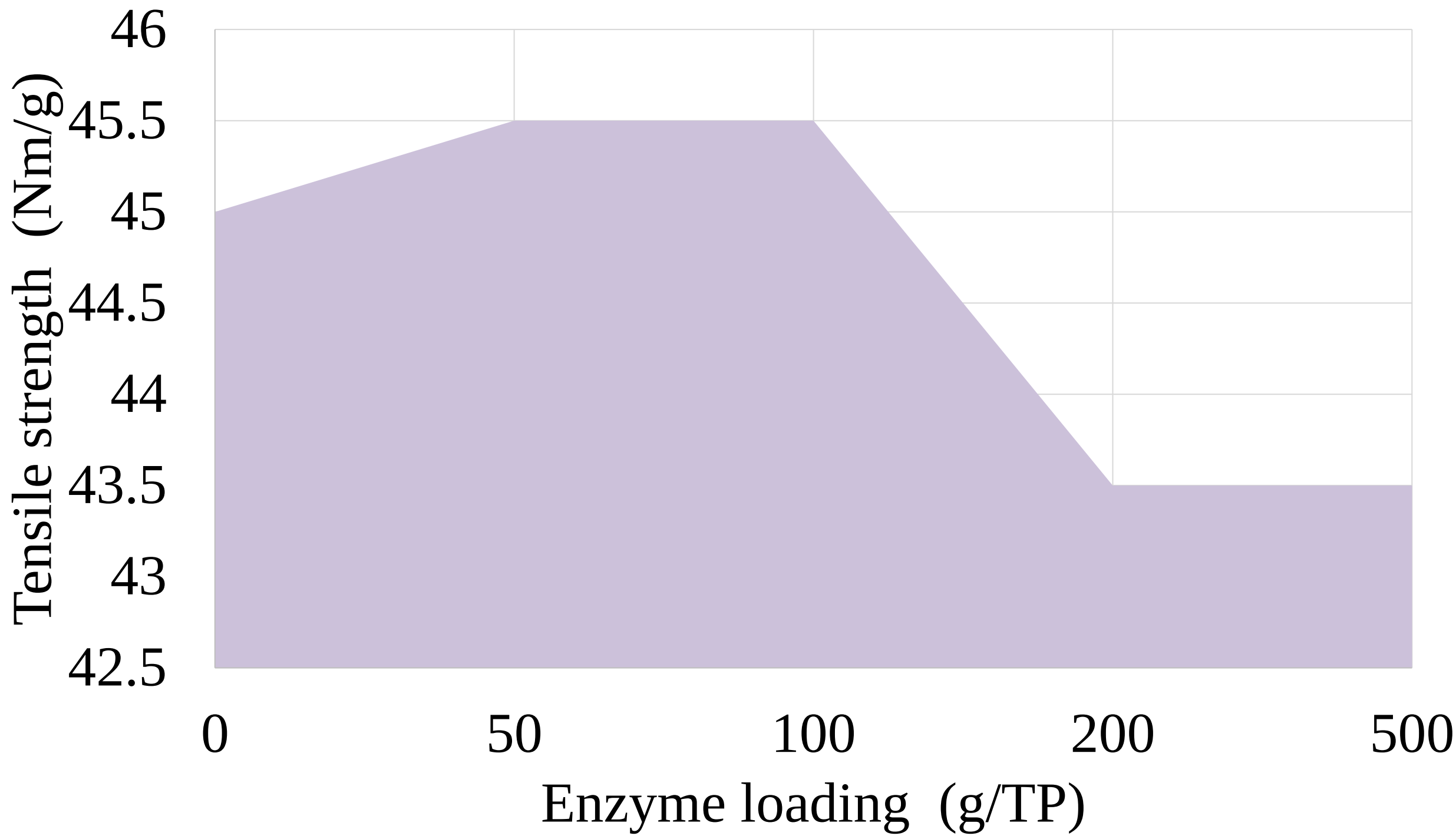


Figure -2: Enzyme Vs Tensile Strength [1] [3]

Increased recycling increases the risk of process interruption. Enzyme loading needs to adjusted according to the quality of recycled pulp.

LIMITATIONS IN PLASTIC RECYCLING

- Closed-Loop recycling needs pure polymer streams.
- Contaminants can destabilize the polymer and cause degradation of polymer properties such as elasticity and impact strength during reprocessing.
- Due to the wide range of polymer present in the waste stream it is difficult to control the effect of contaminant polymer effect on main polymer which is being reprocessed.
- Also at different extrusion temperatures the properties change. Which creates complexity when controlling the properties of the polymer composite as the waste stream has n number of polymers.

Polymer	% of Separation from waste stream
Polypropylene (PP)	96
Polyethylene (PE)	94
Polyethylene terephthalate	94
Polystyrene	87

Table -2: Experimental values at reduced feed rate for polymer separation from waste stream by NIR sensors [5]

The values are obtained in controlled environment with a feed rate of 3Tons/ Hr. but actual capture rates are lower.

Injection Temperature (°C)	PP/PE	Elastic Modulus (MPa)	PP/PE	Impact strength (J/m)
170	100/0	1327	100/0	12.2
	75/25	1143	75/25	26.1
	25/75	426	50/50	41.7
190	100/0	1240	100/0	8.5
	75/25	1085	75/25	25.2
	25/75	404	50/50	28
200	100/0	1452	100/0	4.5
	75/25	1209	75/25	16.3
	25/75	350	50/50	28.5

Table -3: Effect of PE contamination in PP stream on Elasticity and Impact properties. [4]

Polyethylene (PE) contamination has a contrasting effect on the properties of Polypropylene (PP).

CONCLUSION

Due to the above limitations it is not possible to completely recover the resources from waste and maintain product standards for the market. Thus Zero waste is technically not feasible with current material recovery process (recycling).

ACKNOWLEDGEMENT

I would also like to thank entire WTER and CCL group for their valuable input and support.

REFERENCES

- 1 • Partima Bajpai, Recycling and Deinking of recovered paper, Elsevier, 2013, First Edition.
- 2 • Howard R. C., The effects of recycling on paper quality, Journal of Pulp and Paper Science, 16 (5), J143.
- 3 • Shaikh H., & Luo. J., Identification, validation and application of a cellulose specifically to improve the runnability of recycled furnishes, Proceedings of the ninth international technical conference on pulp, paper and allied industry (Paperex'09). New Delhi, India, 4–6 December, 2009, pp. 277–283.
- 4 • R. Strapasson, S. C. Amico, M. F. R. Pereira, T. H. D. Sydenstricker, Tensile and impact behavior of polypropylene/ low polyethylene blends, Polymer testing (24), 2005, 468-473
- 5 • Stuart foster, An assessment of technical, environmental and economic viability of recycling domestic mixed plastics packaging waste in UK, WARP, 2008