INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Development of polymeric foams evolved as major research area due to its unique exclusive properties like lightweight, low density and optimum usage of polymeric materials compared to non-foamed counterparts. However, degradability is a major area of concern for petro-based polymeric foams. The ultimate disposal and environmental aspects of the non-degradable foams leads to the development of bio-based and biodegradable green foams. Major developed biodegradable foam mainly includes starch-based foams, polycaprolactone (PCL) foams, water-soluble polyvinyl alcohol (PVOH) and ethylene vinyl alcohol (EVOH) foam. The applications of these sustainable foams are mainly limited to multilayer packaging applications due to the limitations of oxygen barrier, mechanical properties etc. The improvement in above properties of these foams is a major concern of current research. One of the most promising biodegradable polymers is poly(lactic acid) (PLA) due to its greener routes and comparable properties with some of the conventional petro-based polymers like polystyrene (PS), polypropylene (PP) etc. However, improvement in the properties of PLA-based foams are still lacking in order to substitute the non-degradable foams. The improvement of properties of PLA-based foams can be achieved by incorporation of additives, flame retardants, plasticizers, and so on according to the targeted application. The use of bio-derived nanobiofillers for the improvement of above properties of PLA-based foam provides a greener approach towards the environment point of view. The nanofillers are derived from bio-feedstock that are abundantly available in nature. Therefore, the utilization of these nanobiofillers in PLA foam matrix has both economic and environmental impact. The incorporation of nanobiofillers in the PLA matrix for tailoring various properties is still a growing field of the research.

From the literature, it is observed that a knowledge gap exists towards the fabrication of PLA-based foams using bio-based nanobiofillers for tuning different properties like thermal, mechanical, gas barrier etc. according to the applications. Based on the knowledge gap, the current doctoral research is mainly focused on the development of a hydrophobic, microcellular interconnected, and highly porous PLA-based foam utilizing lab developed bionanofillers like cellulose nanocrystals (CNC), modified chitosan (MC), modified gum arabic (MG) and silk nanocrystals (SNC). Further, no prior art has been observed regarding the incorporation of these bionanofillers in PLA-based foam matrix for proper tuning of different foam properties. The current research has been performed using the less expensive and

innocuous casting and leaching (C/L) technique for foam fabrication utilizing the non-toxic and cost-effective sugar particles as porogen medium. The C/L technique is further modified for better dispersion of porogen particles in the polymer matrix.

The main motivation of the current doctoral research is to investigate the influence of bio-based nanofillers like CNC, MC, MG, and SNC on the foam processing and tailoring of its properties like thermal, wettability, crystallinity, cell size and cell density along with other physicochemical properties. Further, the effect of nanobiofillers in different degradation techniques like thermal, hydrolytic and photodegradation is investigated.