Inherently Safer Process Design applied to Polyhydroxyalkanoates Bioproduction from Wastes

Maria Bolla [a], Margherita Pettinato [a], Vojtech Jankuj [b], Aleš Bernatik [b], Patrizia Perego [a] & Bruno Fabiano [a]

[a] Department of Civil, Chemical and Environmental Engineering, University of Genoa, via Opera Pia, 15, 16145 Genoa, Italy

[b] Faculty of Safety Engineering, VSB - Technical University of Ostrava (VSB-TUO), 17. Listopadu 2172/15, 708 00 Ostrava-Poruba, Czech Republic

E-mail: *maria.bolla01@edu.unige.it*

The inherent safety design is a proactive approach able to eliminate or reduce the root causes of some hazards at the early design stage of a process [1]. This methodology can be applied to compare the relative safety of different chemical process routes by means of specific assessment tools like safety indices and indicators [2]. In these regards, the main aim of this work focuses on an inherent safety development *ad hoc* structured for the polyhydroxyalkanoates (PHAs) production from wastes. Nowadays, the environmental impact deriving from plastic waste represents a global challenge, heightening the urgency to find sustainable alternatives to conventional plastics. PHAs offer a promising solution, being biodegradable biopolymers, synthesized and stored in microbial cells. Their large-scale introduction is still hindered by high production costs, primarily due to the use of traditional carbon sources, such as glucose, which account for up to 45% of the total expenses. This issue can be addressed through the use of alternative carbon substrates like agri-food wastes, which are able to lower the overall production costs and reduce the waste accumulation [3]. With these regards, spent coffee grounds (SCG) were selected as an alternative raw material for the PHA production, following three main steps: SCG pre-treatment, PHA bioproduction, and PHA recovery. Each production phase was investigated from an inherently safer point of view, through the comparison of different process routes. The exploitation of non-conventional technologies led to higher yields and products qualities, but it could entail additional hazards deriving from stricter operational states, that were considered during the preliminary development of the process. In the same way, also biological hazards, introduced by the use of specific microbial strains, were included. Furthermore, the flammability and explosiveness properties of both SCG as such and pre-treated by specific extraction processes were experimentally evaluated, contributing to a knowledge enhance in this field, since dust biomasses currently remain partially unknown, resulting in possible accidents, including fires and explosions.

Keywords: *safety indices, polyhydroxybutyrate, spent coffee grounds, bio-hazards, fermentation, polymer biosynthesis*

References:

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