



Database for accidents and incidents in the biodiesel industry



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ABSTRACT

The present paper describes the development of an accident and incident database for the Biodiesel Industry for the period 2003–November 2013. The work performed is related to the collection of data from different documental sources and the subsequent setting of a database containing general information about adverse events, its sequence, mitigation, causes, and human, environmental and material consequences occurring at biodiesel facilities during the last ten years. This database comes to fill a gap existing in this field. Availability of these data will allow applying risk analysis tools, having a management tool to check organization performance, generating lessons learned to avoid accident recurrence and identifying those accidents more likely to occur. Data statistical analysis shows that the frequency of accidents at biodiesel plants has an increasing tendency, being fires and explosions the main type of accidents that occurred. Immediate causes and consequences of the accidents have also been analyzed. Finally, some conclusions are drawn concerning the need of maintaining an update accidental and incidental database, and improving biodiesel plants safety based on information obtained.

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1. Introduction

Biodiesel has been defined by The American Society of Testing and Materials (ASTM) as monoalkyl esters of long chain fatty acids derived from a renewable lipid feedstock, such as vegetable oil or animal fat. It is an alternative fuel that can be used in pure form or mixed with petroleum-based diesel, with little or no adequacy of engines. It has also environmental advantages such as reduction of carbon emissions. These advantages added to the global perspective of exhaustion of fossil fuels, and the consequently searching of new alternative energy sources has produced a significant increase of biodiesel production. In Fig. 1 it can be seen the important growth of biodiesel production, in particular during the last decade. Data were obtained from the compilation done by Earth Policy Institute, World Biodiesel Production, 1991–2012, (2012).

Biodiesel is broadly produced by transesterification of triglycerides of virgin oils or renewable sources (refined/edible oils), using methanol and alkaline catalysts. Salzano, Di Serio, and Santacesaria (2010b) state that a minimum of 100,000 m³ size is required to consider the plant remunerative. This implies not only an increase of the equipment number but also of the amounts of hazardous and flammable materials being handled. Due to this fact, although biodiesel production processes are simple, operations

involve important risks if expert knowledge and safety technologies are not applied (Rivera & Mc Leod, 2012) and (Rivera & Mc Leod, 2008). It is also clear that not only a big installed capacity is associated to risks, performing unsafe procedures (e.g. welding methanol tanks) and/or the lack of knowledge about them (e.g. mixing glycerine and sulphuric acid in an improper ratio) can create favourable conditions for an accident.

While more relevant accidents at biodiesel facilities have been presented and some of them analyzed in literature (Marlair, Rotureau, Breulet, & Brohez, 2009; Rivera & Mc Leod, 2008; Salzano, Di Serio, & Santacesaria, 2010a; Salzano et al., 2010b; Salzano, Di Serio, & Santacesaria, 2010c) a record or a database that addresses all the accidents and incidents, with details of the facts, information about mitigation measures, probable causes and consequences has not been found yet.

For any industry, availability of data in an organized and systematic way allows:

- having background for risk assessment tools (Haastруп & Rømer, 1995);
- as a management tool, offering to an organization the opportunity to check its performance, learn from its mistakes, and improve its management systems and risk control (Nivolianitou, Konstandinidou, Kiranoudis, & Markatos, 2006);
- capturing valuable information that enables generate lessons learned to avoid accident recurrence (Kirchsteiger, Rushton, & Kawka, 1999);

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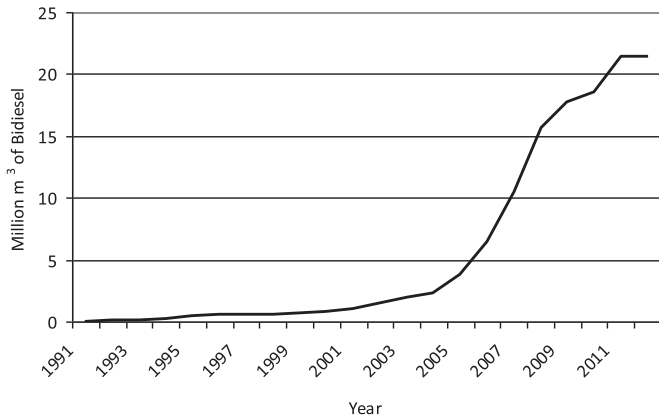


Fig. 1. Biodiesel world production, Million m³ of biodiesel vs year of production.

- identifying main risk sources and establishing what type of accidents are more likely to occur (Planas-Cuchi, Montiel, & Casal, 1997);
- reducing, as a result, the risk of incidents (probability of occurrence and/or the consequences of the incidents);
- finding and extracting information when necessary, in an easy and quickly manner;
- sharing objective information with other companies and third interested to avoid future occurrences (Sepeda, 2006).

This paper describes the procedure used to construct a database at international level to comprehend incidents and accidents in biodiesel plants for the period 2003 to November 2013. Occupational Safety and Health Administration defines *incident* as an unplanned, undesired event that adversely affects completion of a task while *accident* is defined as an undesired event that results in personal injury or property damage (OSHA, 1970). Only events inside biodiesel producer facilities were considered. Residential, road and transport accidents, and in plants under construction were not taken into account. The main purpose of collecting the available information is to gather all disseminated data on accidents, incidents and violations in the biofuel industry and create a reliable database which may be used for the aims described previously.

Section 2 of the paper presents a brief overview of the sources from which accident and incident information was extracted. Section 3 presents the methods used to develop the biodiesel accident database. Section 4 discusses the results obtained from the statistical analysis. Section 5 draws conclusions from the development and the use of the database. Finally, the Appendix presents a summary of collected data in a table.

2. Data sources

The procedure followed to build the biodiesel accident and incident database was similar to that found in papers such as Darbra and Casal (2004), Konstandinidou, Nivolianitou, Markatos, and Kiranoudis (2006), Rosman (2001) among others. It consisted in the collection, analysis and cross checking of the information to obtain a complete and unified register. The following sources were consulted:

- Occupational Safety and Health Administration (OSHA)

OSHA is a national public health agency created in the United States to assure safe and healthful conditions for working men and women by setting and enforcing standards and providing training,

outreach, education and compliance assistance. One of its roles is to conduct workplace inspections in response to workers' reports of hazards or accidental events. Then it elaborates technical reports called "OSHA regional News release" that are available on its webpage (OSHA, 1970).

- Industrial Fire World (IFW)

It is a source of information for industrial fire and emergency responders, and management worldwide. It has three interlinking platforms: IFW magazine provides data bi-monthly, the annual IFW Emergency Responder Conference that draws worldwide managers together giving them a time and a place to learn from each other and look at alternatives offered by new technology and strategy, and the internet platform (Fireworld, 1995) to search articles and incident logs published since 1995.

- Biodiesel Magazine

It is a source dedicated to the coverage of biodiesel news, events and information relevant to the global industry, with editorial focus on U.S. and international methyl ester manufacturing, trade, distribution and markets. It has two platforms: the bi-monthly trade journal and the internet webpage (Biodiesel Magazine) that allows searching articles related to biodiesel industrial safety.

- Biofuels Journal (BioFuels Journal, 2001) and Grainnet (Grainnet)

It is a family of websites that gathers news about the biofuel market and also provides useful information about industrial equipment. Biofuels Journal has a digital edition too.

- Steel Tank Institute (STI)

STI is a trade association representing fabricators of steel construction products and their suppliers. On its webpage (Steel Tank Institute), it is published a document called "Tank and Petroleum Use Mishaps" that contains data about industrial accidents.

- Environmental Protection Agency of United States (EPA, 1970)

It is a government agency concerned with the environment and its impact on human health. It formulates and enforces environmental regulations and helps companies to understand law requirements in order to maintain high environmental standards.

- Articles in academic journals
- Newspapers: national and local publications

3. Methods and data

3.1. Introduction

According to data published in Earth Policy Institute, World Biodiesel Production, 1991–2012 (2012), during the last decade biodiesel production has risen about twenty-seven times respect to that in year 2000. The increasing value given to biodiesel resides in the fact that it is obtained from renewable energy sources, it can be an alternative fuel in the face of declining oil reserves and it has known environmental advantages respect to fossil fuels. Although the process to obtain biodiesel is simple, it is associated to the storage, handling and transportation of flammable and hazardous chemical substances, and to the lack of experience, expert

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