Making Battery Safety Data Sheets Actually Useful to the User

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Introduction

For years Material Safety Data Sheets (MSDSs)[1] have gone hand-in-hand with stationary batteries. Manufacturers and vendors are required to provide them, users are required to file them, and installation and maintenance personnel are supposed to read them. In the USA for really large battery systems, users are required to submit them along with their Emergency Planning and Community Right-to-Know Act (EPCRA) "Tier 1" and/or "Tier 2" inventory reports[2] to the local fire departments and state authorities. It seems to be nothing more than burdensome paperwork. In most cases the MSDSs don't provide much useful information for the EPCRA reports, which want to know the specific chemicals in a battery that might be hazardous. U.S. fire codes require a new installation to declare how much electrolyte is in a battery system, and fire and mechanical codes want to know how much flammable (explosive) gas might be given off by a battery system. Good luck finding that information on an MSDS or manufacturer's data sheet! Other regulations require you to put markings on the battery room door to easily identify the hazards to a fire fighter entering the room with his water hose. In the U.S. this is known as the NFPA 704 Hazard Warning Diamond.[3]

In 2011, the USA harmonized its system of classifying hazardous substances with the European Globally Harmonized System of Classification and Labeling of Chemicals (GHS)[4,5]. The former MSDS is now known simply as a "Safety Data Sheet" (SDS). An IEEE working group is trying to develop a guideline for consistently identifying the hazardous materials in a battery SDS, to include information that is actually beneficial to everyone. This paper describes some of the issues that the working group is grappling with.

Material Safety Data Sheet (MSDS)

An MSDS provides workers and emergency responders with information they need to safely work with any substances that they may come in contact with. The U.S Government's Occupational Safety and Health Administration (OSHA), under the Hazard Communications Standard (HCS) Code of Federal Regulations (CFR) 29 Part 1910.1200, requires that information regarding hazards to be transmitted to employers and employees. The HCS specifies the required elements that must be on an MSDS along with other important data. The Environmental Protection Agency (EPA) requires that MSDSs be on file with state and local emergency planning organizations and fire departments.

In Canada, MSDSs fall under the Workplace Hazardous Materials Information System (WHMIS).[6] In the European Union, they are covered by the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)[7] and by the European Chemicals Agency (ECHA)[8].

MSDS's are required to be created by the manufacturers and passed down to the end user through distributors, equipment supplies, system integrators, and so on. Employers must make them available to employees and ensure that the employees are cognizant about the hazards. State and Local Emergency Planning Commissions (SEPC and LEPC) require that MSDS's be available to emergency responders and to individuals where batteries are stored.

What do Battery User's Need to Know and Report? (USA)

New Battery Installations

- Users report the amount of electrolyte in the battery system. For batteries with liquid electrolyte, including Valve-Regulated Lead-Acid (VRLA) batteries, this should be in gallons/liters. For battery types with non-liquid electrolyte, this should be the weight of the batteries in the system.
- Authorities determine if the battery installation is covered by a fire code based on the battery size.
    - International Fire Code (IFC)[9]: Over 50 gallons of electrolyte for a lead-acid or nickel-cadmium battery or 1,000 pounds of battery weight for a lithium battery.
    - National Fire Protection Association (NFPA–1 Fire Code)[10]. Over 50 gallons of electrolyte in an unsprinklered battery room or 100 gallons in a sprinklered room.

Existing Battery Installations or Storage

- EPCRA "Tier 1" and "Tier 2" inventory reports.
- Hazardous or Extremely Hazardous Substances (EHS).
    - Over 500 lbs. of sulfuric acid.
    - Over 10,000 lbs. of lead.

Nickel-cadmium electrolyte (potassium hydroxide solution) and Cadmium are not classified as EHS.

All Installations

- Users must report the amount of flammable (explosive) gas that can be released from the battery system. This is required to calculate the ventilation required for the battery room. Various codes differ with respect to the percentage by room volume but the most common are the International Fire Code (IFC), the NFPA-1 Fire Code, and the International Mechanical Code, all of which state that these gasses cannot exceed 1% of the air volume in the room. In order to calculate the amount of gases that can be released from a battery, gas evolution must be known for various operating modes of the battery and temperature conditions. Depending on the code, it may be required to calculate the gassing rate at a semi-worst case condition such as equalize or boost charging.
- The amount of toxic gas e.g. hydrogen sulfide that can be released from the battery under fault (thermal runaway) conditions for a valve-regulated lead-acid (VRLA) battery.

Harmonizing the U.S. Laws with European Regulations

- In the USA, chemical substances are classified using the Chemical Abstract Service Registry Number (CASRN)[11] system where every identified hazard is assigned a number.
    - Chemicals are regulated under various laws including the EPA's Toxic Substances Control Act.
- In Europe, The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) is used.

On March 25th 2012, the USA officially adopted the GHS (Revision 3) as a revision of the HCS 29 CFR 1910.1000 to align it with global standards. OSHA calls this revision HazCom 2012. The following are extracts from the summary of this adoption.[12]

"OSHA has determined that the modifications will significantly reduce costs and burdens while also improving the quality and consistency of information provided to employers and employees regarding chemical hazards and associated protective measures … The Agency has concluded this improved information will enhance the effectiveness of the HCS in ensuring that employees are apprised of the chemical hazards to which they may be exposed, and in reducing the incidence of chemical-related occupational illnesses and injuries."

"The modifications to the standard include revised criteria for classification of chemical hazards; revised labeling provisions that include requirements for use of standardized signal words, pictograms, hazard statements, and precautionary statements; a specified format for safety data sheets; and related revisions to definitions of terms used in the standard, and requirements for employee training on labels and safety data sheets. OSHA is also modifying provisions of other standards, including standards for flammable and combustible liquids, process safety management, and most substance-specific health standards, to ensure consistency with the modified HCS requirements. The consequences of these modifications will be to improve safety, to facilitate global harmonization of standards, and to produce hundreds of millions of dollars in annual savings."

The Global Harmonization System (GHS)

The GHS was developed by the United Nations and is a system for standardizing and harmonizing the classification and labeling of chemicals. It is a logical and comprehensive approach to:

- Defining the health, physical and environmental hazards of chemicals.
- Creating a classification process that uses available data on chemicals for comparison with the defined hazard criteria.
- Communicating hazard information, as well as protective measures, on labels and Safety Data Sheets (SDSs).

The GHS is needed because different countries, regulations and systems use different symbols, shapes, colors, etc. which leads to confusion. The following is an extract from OSHA's Guide to the GHS.[5]

"Many countries already have regulatory systems in place for these types of requirements. These systems may be similar in content and approach, but their differences are significant enough to require multiple classifications, labels and safety data sheets for the same product when marketed in different countries or even in the same country when parts of the life cycle are covered by different regulatory authorities. This leads to inconsistent protection for those potentially exposed to the chemicals, as well as creating extensive regulatory burdens on companies producing chemicals. For example, in the United States (U.S.) there are requirements for classification and labeling of chemicals for the Consumer Product Safety Commission, the Department of Transportation, the Environmental Protection Agency, and the Occupational Safety and Health Administration."

"The GHS itself is not a regulation or a standard. The GHS Document (referred to as "The Purple Book" establishes agreed hazard classification and communication provisions with explanatory information on how to apply the system. The elements in the GHS supply a mechanism to meet the basic requirement of any hazard communication system, which is to decide if the chemical product produced and/or supplied is hazardous and to prepare a label and/or Safety Data Sheet as appropriate. Regulatory authorities in countries adopting the GHS will thus take the agreed criteria and provisions, and implement them through their own regulatory process and procedures rather than simply incorporating the text of the GHS into their national requirements. The GHS Document thus provides countries with the regulatory building blocks to develop or modify existing national programs that address classification of hazards and transmittal of information about those hazards and associated protective measures. This helps to ensure the safe use of chemicals as they move through the product life cycle."

The GHS covers all hazardous chemical substances and compounds for all applications and types of use, e.g.:

- Workplace use.
- Consumer use.
- Research and development.
- Production.
- Storage.
- Transport.
- Presence in the environment.

The GHS does not cover “Articles” as defined by OSHA. Users can normally claim exemption from reporting a battery as an “article” because it meets the following three criteria:

- Formed to a specific shape or design during manufacture
- Have end-use function dependent in whole or in part upon its shape or design
- Does not release a toxic chemical under normal circumstances of “otherwise” use at the facility

Material Data Sheet (MSDS) Content

OSHA's Hazard Communication Standard (HCS) specifies certain information that must be included on MSDSs. In order to promote consistent presentation of information, OSHA recommended that MSDSs follow the 16-section format established by the American National Standards Institute (ANSI) standard for preparation of MSDSs, ANSI Z400.1/Z129-1-2010[13]. By following this recommended format, the information of greatest concern to workers is featured at the beginning of the data sheet, including information on chemical composition and first aid measures. More technical information that addresses topics such as the physical and chemical properties of the material and toxicological data appears later in the document.

Under the new GHS ruling, MSDSs will be referred to and called Safety Data Sheets (SDSs). The new standards affect any workplace that manufactures, uses, transports, houses or stores hazardous chemicals such as batteries. One specific change in this ruling is to the ANSI Standardized MSDS format. The original 16-section MSDS format created by ANSI Z400.1 (2010 Rev.) will be replaced by the new SDS under the GHS system for classification for hazardous chemicals.

SDS's are the backbone of the Hazardous Communication System (HCS). They provide comprehensive and specific chemical information used not only by workplaces, but also by emergency responders, poison control centers and transporters of dangerous goods.

The standardized 16-section SDS mirrors the American National Standard for Hazardous Workplace Chemical's - Hazard Evaluation and Safety Data Sheet and Precautionary Labeling Preparation, ANSI Z400.1/Z129-1-2010. To be compliant, the SDS must have all 16 sections. OSHA, however, will not be enforcing sections 12-15 as they fall outside of their jurisdiction.

Safety Data Sheets (SDS’s)

As indicated above, SDSs replace MSDSs and like MSDSs, SDSs enable the employer to:

- Develop an active program for employee protection measures including training specific to a workplace
- Consider measures that are necessary to protect the environment
- Address other entities in safety and environmental needs, e.g. transporters and emergency responders.

The 16-section SDS is becoming the international norm. SDS’s should provide a clear description of the data used to identify the hazards. The 16 sections are:

SECTION 1: Identification of the substance/mixture and of the company/undertaking.

- Product identifier
- Relevant identified uses of the substance or mixture and uses advised against
- Details of the supplier of the safety data sheet
- Emergency telephone number

SECTION 2: Hazards identification

- Classification of the substance or mixture
- GHS label elements, including any precautionary statements.
- Other hazards which do not result in a classification or are not covered by the GHS such as "dust explosion hazard."

SECTION 3: Composition/information on ingredients

- Substances
    - Chemical identity, (e.g., H_2SO_4)
    - Common names or acronyms (e.g., sulfuric acid)
    - CAS number and other unique identifiers
    - Impurities and additives which are themselves classified and which contribute to the classification of the substance.
- Mixtures, e.g. electrolyte.
    - Chemical identity and concentration of all ingredients which are:
        - hazardous within the meaning of the GHS
        - present above their cut-off levels.

SECTION 4: First aid measures

- Description of first aid measures
- Most important symptoms and effects, both acute and delayed
- Indication of any immediate medical attention and special treatment needed

SECTION 5: Firefighting measures

- Extinguishing media
- Special hazards arising from the substance or mixture, e.g. nature of any hazardous combustible products
- Precautionary advice for firefighters and special protective equipment

SECTION 6: Accidental release measures

- Personal precautions, protective equipment and emergency procedures
- Environmental precautions
- Methods and material for containment and cleaning up
- Reference to other sections

SECTION 7: Handling and storage

- Precautions for safe handling
- Conditions for safe storage, including any incompatibilities

SECTION 8: Exposure controls/personal protection

- Control parameters, e.g. occupational exposure limit values
- Exposure controls

- Individual protection measures such as Personal Protection Equipment (PPE)

SECTION 9: Physical and chemical properties

- Information on basic physical and chemical properties
- Other information such as appearance, odor, melting and boiling points, flash point, flammability, and auto-ignition temperature

SECTION 10: Stability and reactivity

- Reactivity
- Chemical stability
- Possibility of hazardous reactions
- Conditions to avoid, e.g. static discharge, vibration
- Incompatible materials
- Hazardous decomposition products

SECTION 11: Toxicological information.

- Information on toxicological effects including:
    - Information on the likely routes of exposure such as inhalation, ingestion, skin and eye contact, etc.
    - Symptoms related to the physical, chemical and toxicological characteristics
    - Delayed and immediate effects and also chronic effects from short and long term exposure
    - Numerical measures of toxicity (such as acute toxicity estimates)

SECTION 12: Ecological information

- Toxicity
- Persistence and degradability
- Bioaccumulative potential
- Mobility in soil
- Other adverse effects

SECTION 13: Disposal considerations

- Waste treatment method. Description of waste residues and information on their safe handling and methods of disposal, including the disposal of any contaminated packaging or handling materials. Battery recycling information should be included.

SECTION 14: Transport information

- UN number
- UN proper shipping name
- Transport hazard class(es)
- Packing group
- Environmental hazards
- Special precautions for user, (e.g., information a user needs to be aware of, or needs to comply with in connection with conveyance within or outside their premises.)
- Transport in bulk according to Annex II of MARPOL73/78[14] and the IBC Code[15]

SECTION 15: Regulatory information

- Safety, health and environmental regulations/legislation specific for the substance or mixture

- Chemical safety assessment

SECTION 16: Other information including information on preparation and revision of the SDS.

The Timetable for Adoption.

The Hazard Communication Standard (HCS) requires that, by June 1, 2015, all modifications to SDSs must be uniform and in compliance with new format requirements. Companies will have until then to train their employees on the new GHS system. U.S. employees will need to be up to date in both the old and new regulations before December 2013. It is thought that this will allow for a smooth transition to the new GHS SDS format. OSHA's final rule imposes the following deadlines on U.S. companies involved with chemicals, and this includes all batteries that fall under the GHS:

- May 25, 2012: Transition period commenced.
- December 1, 2013: Deadline to train employees on new labels.
- June 1, 2015: Deadline to comply with all amended provisions.
- June 1, 2016: Deadline to update alternative workplace labeling and hazard communication programs, and provide any additional employee training.

The Issues with Batteries and the SDSs

There are multiple material classifications. SDSs should show both the CAS and GHS classification of any substance. At present there are inconsistent reporting methods. The same type of information is reported differently from one manufacturer to another. There are different tables, graphs, etc. Information is sometimes given in either metric or imperial; both should be given.

The main problem in creating an SDS is that it is difficult to get the actual quantities of hazardous substances for any given battery model. This data, if given at all, is frequently presented for a product family or even a type of battery, e.g. a VRLA battery. For compilation of EPCRA Tier 1 and Tier 2 reports, it would be extremely helpful if SDSs showed the actual amount of identified substances and electrolyte in each battery model and that is:

- Volume in both gallons and liters.
- Weight in pounds and kilograms (including a separate weight for the sulfuric acid in the electrolyte, or at least the percentage of sulfuric acid in the electrolyte by weight for lead-acid batteries).
- Specific Gravity (SG) of the battery model at full charge and nominal temperature which should be in both Fahrenheit and Celsius.

The requirements for gassing mean that it would be extremely helpful if the SDS included the hydrogen gassing rate under specific conditions. If the manufacturer does not provide this data (always the first and best choice), it can be generally calculated from IEEE 1635 / ASHRAE 21.[16]

It would be a great advantage if the SDSs would include a link to web sites where the information is available for each battery type and model/size.

What is being done about the SDS issue?

An IEEE Stationary Battery Committee, SDS Working Group[17] has been established in order to work on a uniform method of reporting information for stationary batteries. This group is currently seeking industry input and comments.

What's in it for me?

- If you are a user, you will know immediately where to find the information you need in a format that is useable and understandable.

- If you are a supplier, less of your time will be taken up by requests from users requesting this type of information because this information will be readily available.
- If you are an installer, your interaction with Authorities Having Jurisdiction (AHJ) will be minimal and cordial.

Think of how much time can be saved.

Summary

MSDSs have been replaced by SDSs. The information required and contained within the SDS is extensive. Some materials have been, or are being, reclassified. Despite the huge amount of information that is included, the information that is needed to satisfy AHJ's, fire codes, EPA, OSHA, etc. is not easily found, if at all.
The IEEE Working Group is tackling these SDS issues and is soliciting input. IEEE membership is a bonus but is not required for membership in this group. Please contact the authors of this paper for further information.

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Further Reading.

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