JACI Textbook | Learning from social practice cases that received the GSC Awards

Green and
Sustainable
Chemistry

Introduction to GSC

No.6

Received the Minister of Economy, Trade and Industry Award of the 17th GSC Awards (2017)

Development of Low Environmental Load Battery for Idling-Stop System Vehicle with High Charge Acceptance and High Durability

Hitachi Chemical Co., Ltd.
(Currently Energywith Co., Ltd.)
Hitachi, Ltd.

The batteries for use in idling-stop system vehicles developed by Hitachi Chemical (currently Energywith, Tokyo, Japan) show high durability and charge acceptance, enabling rapid charging.
Vehicles equipped with these batteries exhibit improved fuel efficiencies, thereby contributing to reduced CO_2 emissions, which are a cause of global warming.

Outline of the GSC Awards and award-winning company

The GSC Awards are conferred on individuals and organizations that contribute considerably to the advancement of Green and Sustainable Chemistry (GSC), and several awards are conferred each year. Among the awards, the Minister of Economy, Trade, and Industry Award is conferred for contributions to the development of industrial technology; the Minister of Education, Culture, Sports, Science, and Technology Award is conferred for contributions to the development and promotion of science; the Minister of the Environment Award is conferred for contributions to the overall reduction of environmental impact; and the Small Business Award (established in 2015) is conferred upon small and medium-sized businesses that contribute to the development of industrial technology. Moreover, an incentive award is conferred for achievements that should lead to future developments.
Of the businesses operated by Hitachi Chemical Co., Ltd., the manufacture and sale of energy storage devices and the related systems and service business have been taken over by Energywith Co., Ltd.
Hitachi, Ltd. is the core company of the Hitachi Group and one of the world’s leading general electronics manufacturers.

Objective of the textbook series

Global issues, in areas such as resources and energy, global warming, water and food have increasingly become major and complicated concerns. Innovations for achieving both environmental conservation and economic development are needed in order to resolve these issues and realize the sustainable development of society, and expectations for GSC continue to rise. In this textbook series, technologies and products that have received the GSC Awards given to great achievements contributing to the progress of GSC are explained, so that everyone can understand "what is GSC?" and take responsibility for realizing a sustainable society.

*Please refer to The Statement 2015 at the end of the textbook.

What is GSC?

Acronym for Green and Sustainable Chemistry

Definition of GSC

Chemical sciences and technologies which are benign to both human health and the environment, and support the development of a sustainable society

Guidelines of GSC activities

- The chemistry community has been addressing future-oriented research and education, and development towards environmentally-benign systems, processes and products for the sustainable development of society.

- Specifically, in response to the Rio Declaration at the Earth Summit in 1992, the chemistry community has been working in a unified manner linking academia, industry and government to start up Green and Sustainable Chemistry and engage in its activities, in order to advance the pursuance of coexistence with the global environment, the satisfaction of society's needs, and economic rationality. These goals should be pursued with consideration for the environment, safety and health across the life cycles of chemical products, their design, selection of raw materials, processing, use, recycling and final disposal.

- Long-term global issues, in areas such as resources and energy, global warming, water and food, and demographics have increasingly become major and complicated concerns in the present century. Therefore, expectations are growing for innovations, based on the chemical sciences, as driving forces to solve such issues and to achieve the sustainable development of society with enhanced quality of life and well-being.

- The chemistry community will live up to these expectations by strongly advancing Green and Sustainable Chemistry through global partnership and collaboration and by bridging the boundaries that separate industries, academia, governments, consumers and nations.

Examples of GSC

- The general classification is expressed in terms of a combination of the intended social contribution and the means to achieve this goal. With regard to the objectives, the efforts to achieve them have extended in stages from social challenges to difficult long-term challenges, beginning with manufacturing or utilization, and common/basic categories have also been established -

Minimization of resource consumption and maximization of the efficiency of reaction processes for production with reduced environmental impact

1. Chemical technologies and products that lead to reduction in by-product formation and avoid the use of hazardous substances

2. Separation, purification and recycling technologies that reduce the generation and emission of greenhouse gases like CO_2 or toxic/hazardous substances, thus lowering environmental impact

3. Chemical technologies and products that reduce the generation and emission to the environment of greenhouse gases like CO_2 or toxic/hazardous substances

4. Catalysts and reaction processes that realize the saving of energy and resource and improvement in product yields

Risk reduction of chemical substances beneficial to safe and secure living environment

5. Chemical technologies, products and systems that reduce waste generation

6. Chemical technologies, products and systems that inhibit the generation and emission of hazardous substances and pollutants

Challenges to solve energy, resource, food and water issues

7. Chemical technologies, products and systems to utilize low-grade heat sources, non-conventional resources, and other similar alternatives

8. Chemical technologies, products and systems whereby un-utilized energy and resources can be converted into available energy, transported and stored

9. Chemical technologies, products and systems which decrease the dependence on exhaustible resources such as fossil fuels and scarce minerals and promote the shift to renewable energy and resources, including their storage

10. Chemical technologies, products and systems that contribute to the Three R's: Reduce, Reuse and Recycle

11. Chemical technologies, products and systems that promote the efficiency of production and supply of food, and utilization of water resources

Pioneering challenges to long-term issues aiming to realize a safe, secure and sustainable society with enhanced quality of life

12. Chemical technologies, new products and new operational systems that contribute to the introduction of new social systems, for instance based on ICT, and aimed at solving social issues such as energy and resource consumption, food and water security, disaster prevention and infrastructure improvements, transportation and logistics, medical and health care, education and welfare, and other mega-trends of society

13. Chemical technologies, new products and new operational systems that contribute to the improvement of social and individual comfort whilst reducing and preferably inhibiting environmental impact

Systematization, dissemination, enlightenment and education of GSC including its metrics to be established

14. Systematization of GSC practices and concepts

15. Dissemination, enlightenment and education of GSC practices and concepts

16. Establishment and dissemination of GSC metrics

(Definition from JACI GSCN Council
https://www.jaci.or.jp/english/gscn/page_01.html)

Evolution of lead-acid batteries Development of a battery with high charge acceptance and high durability for environmentally friendly idling-stop system vehicles

Hitachi Chemical Co., Ltd.
(Currently Energywith Co., Ltd.)
Hitachi, Ltd.

The Minister of Economy, Trade, and Industry Award at the 17th GSC Awards (FY 2017) was given to Hitachi Chemical Co., Ltd. (currently Energywith Co., Ltd.) and Hitachi for their "Development of Low Environmental Load Battery for Idling-Stop System Vehicle with High Charge Acceptance and High Durability." Idling-stop systems heavily burden on the battery, causing existing batteries to rapidly degrade, with short battery lifetimes. This technology resolves this problem and contributes to the reduction in CO_2 emissions.

1 The path to technology development

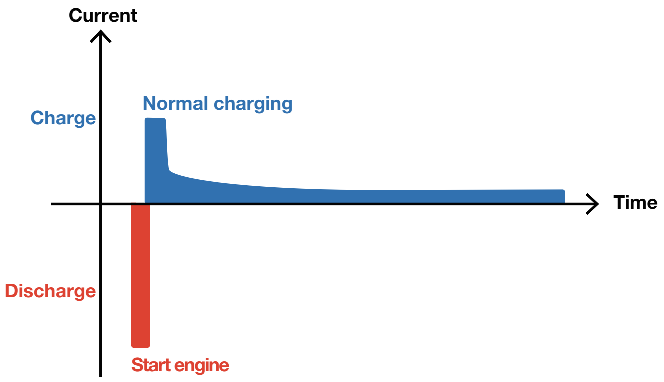
~ What was the motivation that initiated the development of this sustainable progress of society?

Automobiles are essential in everyday life. However, exhaust gas leads to air pollution, and CO_2 in the exhaust gas is a cause of global warming. This large environmental burden is a major problem, and eco-driving and -cars are promoted to reduce this burden. Eco driving refers to driving methods that are environmentally friendly and reduce CO_2 emissions.

Idling-stop systems are a primary example of eco-driving. Idling-stop systems automatically shut off the engine when the vehicle is stationary at a red light or in traffic, thereby reducing fuel consumption and exhaust gas emissions. These systems should significantly contribute to resolving environmental problems. Previously, manually shutting off the engine every time the vehicle stopped was necessary, but almost all vehicles are currently equipped with idling-stop systems that automatically shut off the engine.

Although these systems provide advantages, including reduced environmental burdens and improved fuel efficiencies, the engine is started very frequently, and thus, the starter motor (the motor used to start the engine) is also activated very frequently. The high currents involved when using the starter motor significantly burden the battery, and thus, the performances of traditional batteries generally deteriorate rapidly, resulting in reduced battery lifetimes (Fig.1).

Traditional internal combustion vehicles



Idling stop system vehicles

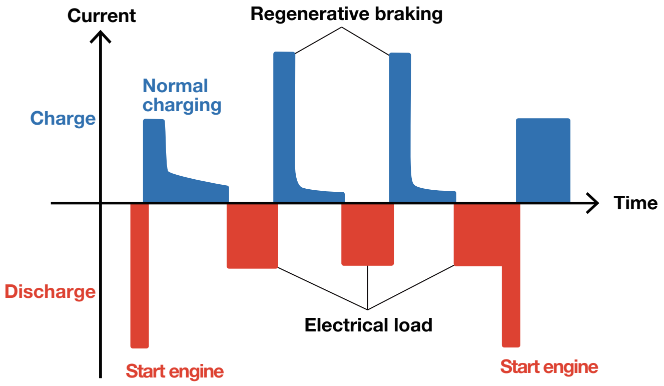


Fig. 1: Use of the battery when starting the engine
Regenerative braking refers to the partial conversion of the kinetic energy to electrical energy under braking, which is then stored in the battery.

The battery should not last long if it simply discharges the stored electric potential. Vehicles are equipped with an electrical generator denoted an alternator, which charges the battery while the engine is running.

When the vehicle is stopped, the engine is shut off and the battery is forced to discharge without charging via the alternator. Therefore, rapid charging of the battery is necessary while the engine is running.

Electrical power is required to operate air conditioning, audio systems, and lamps. If the vehicle stops repeatedly and the battery discharge is too high, the idling-stop system should deactivate to prevent excessive discharge, i.e., the idling-stop system should not function unless the battery is sufficiently charged while the engine is running.

Therefore, the batteries used in idling-stop systems should exhibit high charge acceptance that enables rapid charging, in addition to high durability to withstand the large load requirements.

Column 1

Automotive batteries and their structures

Automotive batteries supply the electrical power required to operate vehicles. In most cases, the battery is located in the engine compartment. The battery comprises a positive electrode, a negative electrode, separator, and electrolyte. The separator prevents direct contact between the positive electrode and negative electrode. This assembly is denoted a cell, and automotive batteries typically exhibit 6 cells connected in series. The cells are housed in a plastic container and provide an electromotive force of 12.6 V. The electrodes are connected to terminals located at the top of the battery.

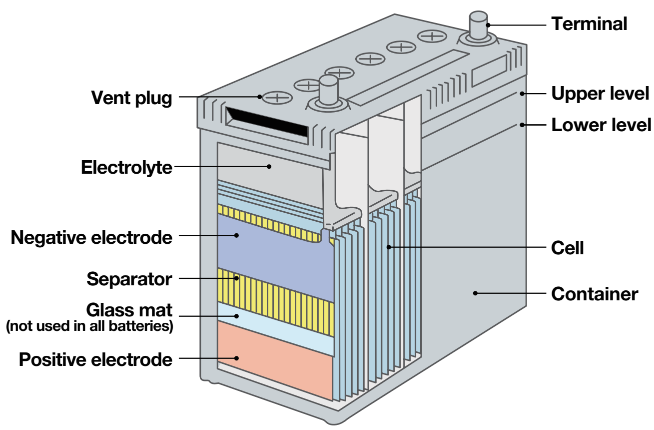


Fig 1: Structure of an automotive battery

2 Toward Resolution of Problems

~ What types of technological challenges did the developers face and how did they resolve them?

Stratification that leads to battery deterioration

Although batteries for use in idling-stop systems require high charge acceptance and durability, these features are challenging to achieve in tandem and involve a trade-off. Considerable effort was required to achieve both simultaneously.

Automotive batteries are traditionally lead-acid batteries (Column 2), and the types used in vehicles with idling-stop systems include the EFB (enhanced flooded battery) and AGM (absorbent glass mat), which are mainly used in Japan and Europe, respectively.

Comparing these two battery types, EFBs exhibit high charge acceptance but low durability, whereas AGM batteries exhibit poor charge acceptance but high durability (Fig. 2).

Because AGM batteries are high-cost, development commenced with the aim of increasing EFB durability to the level of those of AGM batteries.

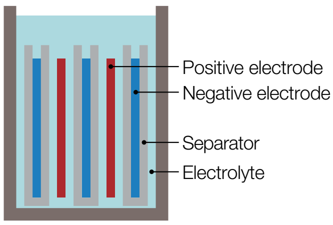
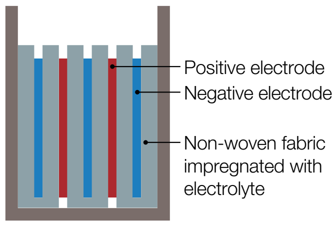
	Item	EFB※1 (Mainly used in Japan)	AGM※2 (Mainly used in Europe)
Structure	Schematic diagram		
Performance	Charge acceptance	High	Low
	Durability	Low	High
Cost		Low	High

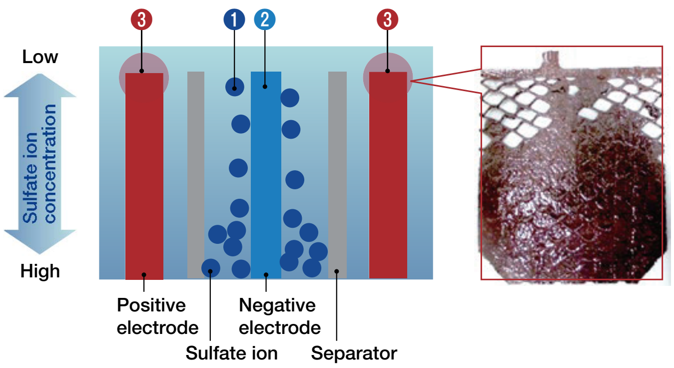
Fig. 2 Comparison of batteries for use in idling-stop systems

※1 EFB…Enhanced Flooded Battery
※2 AGM…Absorbent Glass Mat

The low durability of EFBs are due to stratification of the sulfate ions that are generated at the surfaces of their negative electrodes when charging. Stratification is the separation of sulfate ions into areas of high and low concentrations, resulting in different concentrations in the upper and lower sections of the battery. Heavier sulfate ions generally sink to the bottom of the battery. If the battery is insufficiently charged, no gas is generated at the electrode*1, and the electrolyte is not mixed, allowing the sulfate ions to settle at the bottom.

Upon stratification, the lead sulfate formed during battery discharge crystallizes in the lower section of the battery with high ion concentrations, causing the deterioration in electrode performance. This is denoted “sulfation”, and as it progresses and the crystals accumulate on the electrode, the battery capacity and charging rate decrease. In addition, the charging and discharging reactions are concentrated in the upper section of the battery with low ion concentrations, which causes the electrodes to deteriorate more easily. At the positive electrode, in particular, “flaking” generally occurs, wherein the lead oxide flakes off the electrode (Fig. 3).

*1
Hydrogen gas and oxygen gas are generated by the electrolysis of water during charging.



1 Sulfate ions form at the surface of the negative electrode during charging

2 Stratification (sulfate ion sedimentation)

3 Charging and discharging reactions are concentrated in the upper part of the battery, causing electrode plate deterioration

Fig. 3 Deterioration of EFBs
EFB performance deteriorates due to stratification.

To prevent battery deterioration and loss of function, it is necessary to prevent the stratification of the sulfate ions into areas of high and low concentration and ensure consistent concentration throughout the battery.

Evaluation of the fiber layer

In AGM batteries, the separator is filled with an electrolyte. As a result, sulfate ions do not easily sink to the bottom, preventing stratification and increasing the battery durability. Therefore, the EFB battery was improved by adding a fiber layer between the negative electrode and separator to prevent sulfate ion stratification. Through the inclusion of a fiber layer, no concentration gradient forms in the electrolyte, making it possible to maintain consistent electrode function from top to bottom.

Conversely, the mutual interactions between the sulfate ions and fiber layer molecules altered the diffusion of the sulfate ions, which could result in poor charge acceptance. The design of the fiber layer began with the aim of identifying materials and structures that enabled sulfate ion diffusion without lowering charge acceptance for use in the fiber layer.

With cooperation from the Hitachi's research center, dynamic simulations were conducted to investigate the motions of sulfate ions within the fiber layer. The movements of the sulfate ions and their interactions with the fiber layer were investigated by changing multiple parameters, including the thickness and porosity of the fiber layer, to realize a high charge acceptance and durability.

The simulations indicate that the diffusion coefficient*2 of the sulfate ions and the surface tension*3 of the fibers correlate, with a maximum diffusion coefficient at the corresponding surface tension (Fig. 4). Therefore, when the surface tension of the fibers is high, the interactions with the sulfate ions are stronger, and as the diffusion coefficient increases, charge acceptance improves. Therefore, adjusting the surface tension of the fiber layer may lead to a large improvement in charge acceptance.

Therefore, adjusting the surface tension of the fiber layer may lead to a large improvement in charge acceptance.

*2
The proportionality constant indicates the rate at which molecules diffuse within a medium. It is defined as the volume of matter moving per unit area per unit time based on a known concentration gradient. The units are [m^2/s].

*3
Property that acts to minimize the surface area of a liquid or solid.

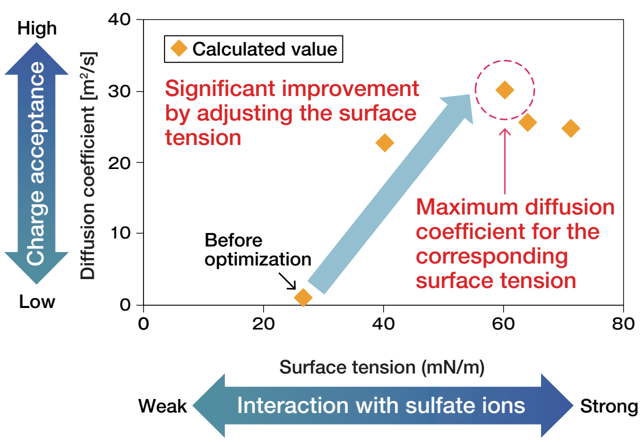


Fig. 4 Results of the dynamic simulation
The results suggested that the diffusion coefficient and surface tension are correlated and there exists a maximum diffusion coefficient for the corresponding surface tension.

The results are obtained via a simulation, and if this relationship is not confirmed in reality, proceeding with development should be impossible. Hence, evaluating the diffusion coefficient and surface tension of the fiber layer is necessary. With the assistance of the Hitachi's research center, a method of evaluation was established. The diffusion coefficient was evaluated based on the changes in conductivity when sulfuric acid diffused through the fiber layer. The surface tension was evaluated based on the contact angle of a sulfuric acid droplet on the surface of the fiber layer.

Column 2

Lead-acid batteries

In general, automotive batteries are lead-acid batteries. These batteries may be charged using an external power source and reused multiple times. Such batteries are denoted secondary (storage) batteries. In addition to lead-acid batteries, other types of batteries currently in use include nickel-metal hydride and lithium-ion batteries.

In lead-acid batteries, the positive electrodes and negative electrodes are composed of lead (IV) oxide (PbO_2) and lead (Pb), respectively. Diluted sulfuric acid (H_2SO_4) is used as the electrolyte, and the electromotive force is approximately 2.1 V per cell. During discharge, lead reacts with sulfuric acid at the negative electrode to form lead (II) sulfate. At the positive electrode, lead (IV) oxide accepts electrons to form lead (II) sulfate, which adheres to the electrode. When the battery is directly connected to a power source to charge, a reverse reaction occurs, and the battery returns to its original state. During discharge, the half-reaction at the negative electrode is

$$Pb + SO_4^{2-} \rightarrow PbSO_4 + 2e^-$$

and the half-reaction at the positive electrode is

$$PbO_2 + 4H^+ + SO_4^{2-} + 2e^- \rightarrow PbSO_4 + 2H_2O$$

The overall reaction in the battery may be written as

$$Pb + PbO_2 + 2H_2SO_4 \underset{\text{Charge}}{\overset{\text{Discharge}}{\rightleftarrows}} 2PbSO_4 + 2H_2O$$

Aiming to achieve both high charge acceptance and high durability

First, prototype fiber layers were fabricated using different parameters, such as thickness and fiber density. As the fiber layer narrowed, the internal resistance acting on the electrolyte decreased, rendering the diffusion of sulfate ions easier, leading to improved charge acceptance. In addition, the surface tension was adjusted by coating the individual fibers in the fiber layer to increase their hydrophilicities. The coated fibers were observed using scanning electron microscopy, which confirmed that the coating remained stable even when submerged in sulfuric acid.

When the diffusion coefficient is measured using fiber layers with different surface tensions, revealing the correlation between the diffusion coefficient and surface tension is possible, along with the maximum diffusion coefficient, as indicated by the simulation results (Fig. 5). Thus, a fiber layer with a surface tension that maximizes the diffusion coefficient, which is key in determining charge acceptance, was identified, and the development proceeded.

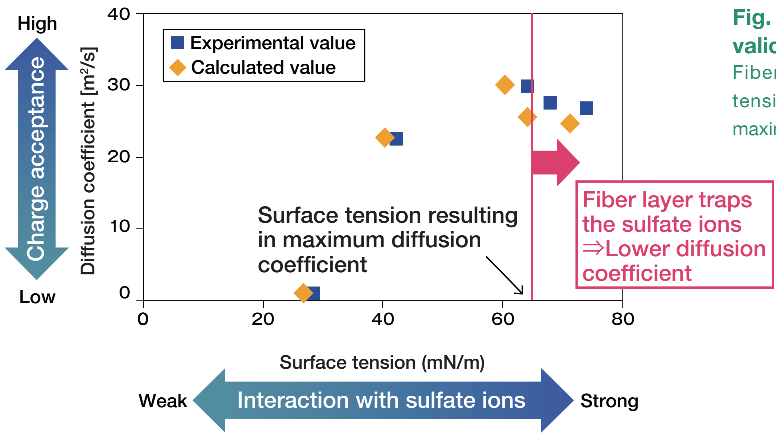


Fig. 5 Results of experimental validation
Fiber layers with different surface tensions were used to confirm the maximum diffusion coefficient.

Journal of Energy Storage 16 (2018) 197-202

Thus, a battery was created with a fiber layer between the negative electrode and separator, and the stratification was evaluated by measuring the sulfate ion concentrations in the electrolyte at the top and bottom of the battery. Compared with that of the product prior to modification, the addition of the fiber layer reduced the stratification.

In addition, in the durability studies, the lifetime of the battery increased in terms of the number of charge cycles, indicating a considerably increased durability.

3 Contribution to Society

~ What is the contribution of this novel technology to society?

Hitachi Chemical Co., Ltd. (currently Energywith Co., Ltd.) launched this novel battery with a high charge acceptance and durability in June 2016 as the "Tuflong G3" battery for use in idling-stop system vehicles. With a product warranty of 38 months, Tuflong G3 shows a battery life of approximately 2.1 times those of existing batteries.Using this battery improves fuel efficiency via its rapid charging while the engine is running and maintains the idling-stop function for an extended duration. The resulting improved fuel efficiency should lead to lower overall CO_2 emissions. Based on the reduction in CO_2 emission per idling-stop system vehicle equipped with a Hitachi Chemical Co., Ltd. (currently Energywith Co., Ltd.) battery and the number of vehicles equipped with such batteries, the technology is estimated to reduce CO_2 emissions by approximately 750 000 metric tons annually.

Owing to the increased use of eco-driving and the prevalence of eco-cars, CO_2 emissions from vehicles declined recently. The number of vehicles with idling-stop systems, which improve fuel efficiency by reducing unnecessary fuel consumption, has increased to the point where obtaining a vehicle not equipped with such a system is challenging. With previous automotive batteries, sufficiently utilizing this function was impossible, but the novel technology should enable increased utilization of the idling-stop function and contribute to reducing CO_2 emissions.

Of the 1.138 billion metric tons of CO_2 emitted in Japan in 2018, vehicles accounted for 15.9%. Under the Paris Agreement*4 signed by over 100 nations in 2015, these nations aim to eliminate greenhouse gas emissions, such as CO_2, by the latter half of the 21st century, and the global trend toward reducing CO_2 emissions should accelerate further. We intend to expand this technology overseas and contribute to reducing global greenhouse gas emissions.

*4 Adopted at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21) held in Paris, France in December 2015. This is a new international framework for reducing greenhouse gas emissions by 2020.

Column 3

What is a battery?

A battery is a device that produces an electrical current via a chemical reaction. The chemical energy stored in physical matter is converted to electrical energy. When two metal plates with different ionization tendencies are placed in an electrolyte, producing electrons at the plate with a high ionization tendency and creating an electrical current toward the plate with a low ionization tendency are possible.

Primary batteries are single-use batteries that are designed to be discarded when the stored energy is consumed. Commonly used batteries include manganese and alkaline dry cell batteries, in addition to lithium primary, silver oxide, and zinc-air batteries. Batteries that may be recharged and reused after the stored energy is consumed are denoted secondary batteries. Lead-acid batteries are the oldest type of secondary batteries and are often used in vehicles. Other types include nickel–cadmium, nickel-metal hydride, and lithium-ion batteries. Hybrid vehicles use nickel-metal hydride and lithium-ion batteries.

Recently, the use of lithium-ion batteries increased. These store and discharge electricity via the movement of lithium ions between the positive electrode and negative electrode. Compared to those of nickel-cadmium and nickel-metal hydride batteries, they generate several-fold more energy at similar sizes. Therefore, they exhibit extended run times, and combined with their light masses, lithium-ion batteries are well-suited as power sources for use in small devices, such as mobile phones. In addition, lithium-ion batteries exhibit extended lifetimes and low levels of self-discharge. In 2019, Dr. Akira Yoshino, Honorary Fellow at Asahi Kasei Corp., was awarded the Nobel Prize in Chemistry for his achievements in developing lithium-ion batteries.

Questions

For deeper understanding

Please refer to these case studies as you consider the following questions from the viewpoint of GSC (Green and Sustainable Chemistry).

Q1 Please discuss, with reasons, which example of GSC is the optimal match for the technology and product described in this teaching material.

Q2 GSC is complete only after its implementation in society. To do so, three aspects should be fulfilled simultaneously: coexistence with the global environment, satisfaction of the demands of society, and economic rationality. For example, please summarize how measures were devised to satisfy, not only the coexistence with the global environment and satisfaction of society's needs, but also economic rationality in the case study of the technology and product in this teaching material.

Q3 When a lead-acid battery is charged, the reactions proceed in the opposite direction to the reactions indicated in Column 2. Assuming a charge of 1 mol of electrons, please calculate the mass of sulfate ions generated at the electrode.

Q4 Looking at the half-reaction formula for lithium ion batteries, how does the standard electrode potential compare to that of lead-acid batteries?

Q5 Please explain the relationship between this technology and the SDGs.

Q6 Evaluate this technology in accordance with the GSC assessment method.

Literature

Helpful materials

1) *Environment and Chemistry, Introduction to Green Chemistry, 3rd Ed.* (in Japanese), ed. by K. Ogino, S. Takeuchi and H. Tsuge, Tokyo Kagaku Dojin, Tokyo, 2018
2) *Understanding Batteries – An Introduction to Electrochemistry* (in Japanese), M. Watanabe, Y. Katayama, Ohmsha, Ltd.
3) *The Manga Guide to Battery Cells* (in Japanese), K. Fujitaki, Y. Sato, Ohmsha, Ltd.

The Statement 2015

We, the participants of the 7th International GSC Conference Tokyo（GSC-7）and 4th JACI/ GSC Symposium make the following declaration to promote “Green and Sustainable Chemistry（GSC）” as a key initiative in the ongoing efforts to achieve global sustainable development.

The global chemistry community has been addressing future-oriented research, innovation, education, and development towards environmentally-benign systems, processes, and products for the sustainable development of society.

In response to the Rio Declaration at the Earth Summit in 1992 and subsequent global Declarations, the global chemistry community has been working on challenges in a unified manner linking academia, industry, and government with a common focus to advance the adoption and uptake of Green and Sustainable Chemistry. The outcomes include the pursuance of co-existence with the global environment, the satisfaction of society’s needs, and economic rationality. These goals should be pursued with consideration for improved quality, performance, and job creation as well as health, safety, the environment across the life cycles of chemical products, their design, selection of raw materials, processing, use, recycling, and final disposal towards a Circular Economy.

Long-term global issues, in areas such as food and water security of supply, energy generation and consumption, resource efficiency, emerging markets, and technological advances and responsible industrial practices have increasingly become major and complicated societal concerns requiring serious attention and innovative solutions within a tight timeline. Therefore, expectations are growing for innovations, based on the chemical sciences and technologies, as driving forces to solve such issues and to achieve the sustainable development of society with enhanced quality of life and well-being.

These significant global issues will best be addressed through promotion of the interdisciplinary understanding of Green and Sustainable Chemistry throughout the discussion of “ Toward New Developments in GSC. ”

The global chemistry community will advance Green and Sustainable Chemistry through global partnership and collaboration and by bridging the boundaries that traditionally separate disciplines, academia, industries, consumers, governments, and nations.

July 8, 2015
Kyohei Takahashi
on behalf of Organizing Committee
Milton Hearn AM, David Constable,
Sir Martyn Poliakoff, Masahiko Matsukata
on behalf of International Advisory Board
of 7th International GSC Conference Tokyo（GSC-7）, Japan July 5-8, 2015

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GSC : Green and Sustainable Chemistry

Chemical sciences and technologies
which are benign to both human health and the environment,
and support the development of a sustainable society.

Introduction to GSC

Learning from social practice cases that received the GSC Awards

Global issues, in areas such as resources and energy, global warming, water and food have increasingly become major and complicated concerns. Innovations for achieving both environmental conservation and economic development are needed in order to resolve these issues and realize the sustainable development of society, and expectations for GSC continue to rise. In this textbook series, technologies and products that have received the GSC Awards given to great achievements contributing to the progress of GSC are explained, so that everyone can understand “what is GSC?” and take responsibility for realizing a sustainable society.

Special Edition

“Introduction to SDGs” Sustainable Development Goals GSC plays a driving role in SDGs

Let's change the world towards a sustainable future!

The SDGs are global goals adopted by the United Nations, and it is essential to harmonize the three elements of economy, society, and the environment in order to achieve sustainable development. This way of thinking is shared with the GSC, which aims to achieve both environmental conservation and economic development for the sustainable development of society. As a special issue, this text aims to explain the SDGs from the perspective of the GSC and encourage everyone to think about and put them into practice.

No.1

New laundry proposal for pioneering a sustainable society

Kao Corporation

The "new laundry proposal for pioneering a sustainable society" of Kao Corporation, which received the Minister of Economy, Trade and Industry Award of the 12th GSC Awards (2012), is characterized by the introduction of Life Cycle Assessment (LCA) into the development of laundry detergents, and the proposal to reduce laundry-related environmental impacts together with consumers by using just one rinse cycle in laundry. How was this innovation generated that simultaneously satisfies environmental friendliness, social contribution and economic rationality?

No.2

Novel Non-phosgene Polycarbonate Production Process Using By-product CO_2 as Starting Material

Asahi Kasei Corporation

The great success of this technology is that unlike the conventional polycarbonate production process, it does not use toxic phosgene as a starting material. At the same time, the technology was revolutionary because it achieved saving of both resources and energy. More than 10 years have passed, and the technology has been widely commercialized all over the world. This worldwide use was highly regarded, and the process became the first technology by a Japanese company to receive the Heroes of Chemistry Award from the American Chemical Society in 2014. What kind of technology is involved in this world-renowned polycarbonate production process?

No.3

Development of Carbon Fiber Composite Materials for Lightweight Commercial Airplanes

Toray Industries, Inc.

TORAY's carbon fiber reinforced plastic developed through over 40 years of research and development has features of high toughness (material tenacity) in combination with light weight and flexibility. The high toughness carbon fiber reinforced plastic (high toughness CFRP) realizes weight reduction of airplanes which is effective in improving fuel consumption, and makes a substantial contribution to reducing environmental impact.

No.4

Development and Commercialization of High Performance Transparent Plastics Derived from Plant-Based Raw Material

Mitsubishi Chemical Corporation

"DURABIOTM", the transparent engineering plastic made from renewable resources developed by the company, not only contributes to the reduction of environmental impact, but also realizes performance exceeding that of conventional engineering plastics in terms of optical characteristics, weathering resistance, etc.

No.5

Development of High-Performance Reverse Osmosis Membrane Contribution to the solution of global water issues

Toray Industries, Inc.

This reverse osmosis membrane can be used in not only seawater but also river water, sewage wastewater, and various other water treatment systems, providing high quality water while saving energy.

No.6

Development of Low Environmental Load Battery for Idling-Stop System Vehicle with High Charge Acceptance and High Durability

Hitachi Chemical Co., Ltd.
(Currently Energywith Co., Ltd.)
Hitachi, Ltd.

Idling-stop systems heavily burden on the battery, causing existing batteries to rapidly degrade, with short battery lifetimes. This technology resolves this problem and contributes to the reduction in CO_2 emissions.

No.7

Development of Water-based Inkjet Ink for Food Package

Kao Corporation

Kao Corporation developed a “water-based inkjet ink” for printing on the plastic films used for packaging daily commodities and food.
The ink maintains a high image quality and has lower volatile organic compound emissions, thereby reducing its environmental impact.

No.8

Development and Commercialization of a New Manufacturing Process for Propylene Oxide Utilizing Cumene Recycling

Sumitomo Chemical Co., Ltd.

Sumitomo Chemical Co., Ltd. developed a new manufacturing process for propylene oxide, which is used as a raw material for polyurethane and other materials.
The new process enables high yields of propylene oxide while reducing its environmental impact.

You can read them in “PDF” and “HTML” that is easy to read on mobile phones.

Please take a look!

https://www.jaci.or.jp/english/gscn/GSCgs/spmenu/page_19_01_sp.php

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