廃棄物資源循環複合領域研究寄附講座

Multidisciplinary Research on the Circulation of Waste Resources

- 資源再利用 **Material reutilization**
- 都市鉱山に関するプロセス開発 **Process development for urban mining**
- 大規模災害復旧活動におけるインテリジェンス活動 **Intelligence activities for waste management concerning disaster recovery**

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1. Future Earth: Feasibility study on the development of a recycling and material cycle system in Bandung (Indonesia)

In the line with Future Earth program, established by the United Nations, the possibility of developing a recycling system for Bandung in Indonesia is under investigation. In cooperation with the Institut Teknologi Bandung (ITB), we develop a system of waste management and avoidance, which is in agreement with the local culture and tradition. Special focus is set on the cooperation with Indonesian stakeholders and the general public.

2. Study on boron removal from wastewater via coagulation sedimentation with ettringite

Boron compounds largely used in industrial processes may pose health risks to humans and animals due to unpredictable emissions to the environment. The coagulation process using ettringite as a boron purifying agent is known to be economically feasible. The water treatment method and mechanism were investigated.

3. Electrochemical reduction of CO_2

For the limitation of the green house effect, renewable energy can be used for the electrochemical reduction of CO_2. In this way, valuable chemical substances such as CO, formic acid or methanol are obtained. Important factors are energy efficiency and product selectivity, which are strongly affected by the choice of an appropriate catalyst.

4. The 3rd UN World Conference on Disaster Risk Reduction in Sendai PUBLIC FORUM

The 3rd UN World Conference on Disaster Risk Reduction took place in Sendai from March 14th to 18th. Our group organized a session within the public forum regarding the application of aerial and satellite images for the analysis of major natural disasters.

1. Future Earth: Feasibility study on the development of a recycling and material cycle system in Bandung (Indonesia)

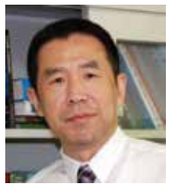
In 2012, the United Nations launched the Future Earth research program within the UN Conference on Sustainable Development (Rio+20). Aim is the support of sustainable development in a changing world. One of the biggest problems for the development in many countries is the increasing amount of waste. Especially in developing countries, many resource are dumped in open landfills (Fig.1), causing environmental problems and endanger human health. Moreover, the goal must be to integrate resources from waste streams into a sustainable material cycle. This is only achieved with the support of the local communities and in accordance with the traditions of the local people. Therefore, solutions that are practiced in industrialized countries might not be accepted in all parts of the world.

Waste separation as practiced in Japan is not known in Indonesia. Some waste is collected by junkman going from door to door paying money for recyclables such as old electronic devices or paper. Other waste is brought by consumers to waste banks, where it is stored until it can be sold. Then the consumer gets money in return. However,most of the waste is unseparated disposed in landfills, where scavengers look for recyclable plastics (Fig. 2). The current price for 1 kg of waste polyethylene terephthalate (PET) is about 30 Yen.

In our research, the aim must be to find a way to keep more materials in the material cycle; especially biowaste offers interesting opportunities for energy conversion and as a replacement for chemicals conventionally made from fossil fuels. However, new ways of waste management have to be accepted by the population and people working already in the field of waste separation have to be included in the new system.

Fig.1 Landfill at Sarimukti, Bandung (Indonesia).

Fig.2 Collected and separated plastic waste at the landfill site of Sarimukti.



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2. Experimental and mechanism study on boron removal from wastewater via coagulation sedimentation with ettringite

Boron compounds that are largely being used in industrial processes may pose health risks to humans and animals due to unpredictable emissions to the environment. Nowadays, the boron (including its compounds) emission standard in Japan requires a more thorough removal of boron from all effluents than previously. Compared to other novel technologies, the coagulation process using ettringite as a purifying agent is known to be more economically effective, but the sophisticated water treatment method and mechanism have rarely been described. In this study, we wanted to clarify the boron removal mechanism by batch tests followed with measurement and data analyses on B, Ca, Al and SO_4^{2-} in both the liquid and solid phases. Results indicate increasing the pH from 10 to 13 enhances the removal of B (boric acid) and also changes the amount of Ca, Al and SO_4^{2-} (S and O) in both phases. The mechanism suggested is that in aqueous solutions at high pH, OH- can drive certain amounts of SO_4^{2-} and $Al(OH)_4^-$ out of the boro-ettringite. The oral presentation was made in IEEC 2015 (Oct. 28-30, Busan, Korea (Fig. 3).

3. Study on electrocchemical reduction of CO_2 to low-carbon fuel

Carbon dioxide (CO_2) produced by extensive fossil fuel consumption and excess industrial processes could make carbon imbalance in the world, creating negative impact on environment through greenhouse effect. One of the feasible ways to reduce CO_2 emission is to convert it to useful fuels by using clean and sustainable energy from solar, wind, hydropower, etc.. Among different conversion technologies, electrochemical reduction of CO_2 to produce low-carbon fuels, such as CO and HCOOH or $HCOO^-$, has been demonstrated to be feasible and efficient. We have developed Sn, Cu and Co-containing catalysts for the purpose by a Sino-Japan co-operation study. Some desirable results have been published (Fig. 4).

4. The 3rd UN World Conference on Disaster Risk Reduction in Sendai PUBLIC FORUM

(March 14-18, 2015, Sendai, Japan)

Analysis of aerial photographs and satellite images for the estimation of mega-disaster waste in devastated areas

Areas devastated by mega-disasters suffer from severe damages of their infrastructures. Lack of information prevents fast reconstruction of the affected areas. The analysis of aerial photographs and satellite images can be employed to gather information of the affected areas necessary for their reconstruction. The results can be widely used for planning the tasks required for recovery such as scheduling the waste removal and the business recovery process for companies, etc. The aim of the forum is to introduce our effort to detect the damaged building and to estimate the amount of disaster debris (waste) by using aerial photographs and by satellite images, and to discuss the future perspective of applying the results to disaster waste transport planning and water resource management system.

Fig.3 (co-)chairmen and speakers in IEEC 2015

Fig.4 Publications on electrochemical reduction of CO_2.

Fig.5 Flyer and venue scene of the 3rd UN World Conference on Disaster Risk Reduction