Linnaeus ECO-TECH ´10
Kalmar, Sweden, November 22-24, 2010

COMPETENCE CENTRE RECYCLING, CCR

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ABSTRACT

Competence Centre Recycling is a multi-disciplinary research group doing research in a wide area of industrial material recycling in close collaboration with our industrial partners.

KEYWORDS

Multi-disciplinary; Recycling; Industrial applications.

1 BACKGROUND

The initiative to set up a Competence Centre came as a professorship in Industrial material recycling was established. The professorship is funded by Stena Metal and held by Christian Ekberg.
The intention with the professorship and the Competence Centre as well is to strengthen material recycling as a research area, as it has been almost completely overlooked in the scientific community until quite recently. That may seem a bit strange, given the attention that is otherwise paid to recycling and recycling related issues in society nowadays. In politics, industry and also in the public service information to the citizens and consumers, recycling has been a big issue some years back, but the scientific community has been pretty quiet in this issue. It is CCR's intention to contribute to a change of that.

The idea was from the outset that CCR should be of multi-disciplinary nature, and build a broad scientific expertise from different disciplines (and also from different universities). Now, CCR has members from the following disciplines: Environmental System analysis, Practical Philosophy, Environmental Science, Industrial Material Recycling, Materials and Manufacturing Technology, Nuclear Chemistry, Environmental Inorganic Chemistry, Chemical Engineering Design, Physical Resource Theory and Environmental Technique. None of these scientists spend throughout their working to CCR, but all have their services as lecturers or professors at respective departments. To be a member of CCR is rather a possibility for the researchers to broaden their networks and a possibility to develop joint research projects for a shorter or longer time, and a way to contribute to the development of this relatively new research area, than to find a new full time job. CCR has also a project coordinator, which is a part time employee and at the same time one of the centre's researchers.

The researchers' membership in CCR is of informal nature. New members enter the group as the need arises for additional disciplines and competences, or as contacts are made. The wide spread topic is interesting and deserves a closer look. It is not uncommon that cross-disciplinary collaboration between researchers is marked by misunderstandings and conflicts, probably as a result of different training, terminologies and methodologies. In this regard, CCR has so far managed very well to remain free of conflicts. We meet and plan our projects

https://doi.org/10.15626/Eco-Tech.2010.115

in a spirit of almost a rare lack of prestige. Our guests and new members do often comment on that. We do not know really why it is so, and perhaps we have just been lucky. However, it would probably be interesting to see if there is something to learn from multi-disciplinary cooperation, through a more systematically review and of the cooperation in CCR. Of course, respect for each other's knowledge and awareness that others' knowledge is needed to make the whole thing is important here, but it still does not explain why multi-disciplinary cooperation is so often so much harder than it has so far been for us.

In addition to the researchers that are considered as members of the CCR, we also have a Steering Group and a Reference Group.

The steering group comprises representatives of the companies who contribute financially or otherwise to any of our research. Hence, its composition is changing as we initiate or end the collaboration on various research projects. It also means that the steering group size may vary based on how many companies we work with at the time.

For the moment, our economic cooperation with the companies is that they contribute to specific research projects that are of interest for their own affairs, and they have a representative in the Steering Group for the duration of this project is ongoing. An exception is Stena Metall, which as well as finance the chair of industrial recycling also contributes to research. The funding from Stena Metall does not relate to any specific research project, but is more open in nature. An ideal development for the CCR would be to find more industry partners, both those who want to cooperate on specific projects, such as those who want to support "general" research in recycling for a longer or shorter period.

The steering group is not a board in the formal sense. Instead, the aim of the group is to get our industry partners comments on what we are doing and to keep our industry partners informed.

CCR also has a reference group. It includes people from industry, academy and politics. The reference group meets once or twice a year, to continuously evaluate and inspire the CCR's work. Reference Group members are appointed by Chalmers and Stena Metall.

Throughout, one can say that the CCR's organization form is of an informal nature. That can certainly contribute to the organization appears as unclear, but so far we believe that the advantages outweigh the disadvantages. We can easily link to our new members and initiate new collaborations without significant formalities. As the research area still is relatively new, we do not know what challenges even the near future will offer. We believe that an open and informal organization easier is ready for the news, and to shape itself according to what is happening, than what a firmer and better-defined form of organization would have been.

2 MULTI-DISCIPLINARY RESEARCH IN RECYCLING – OUR ONGOING RESEARCH

Multi-disciplinary research is in some ways encouraged by the research policy and education policy. Despite that, there are very few forums for multi-disciplinary research and it is hence sometimes difficult to find appropriate journals to publish the results of multi-disciplinary research. Both multi-disciplinary and recycling appear to be in time, as buzzwords, almost. It

is a bit surprising, then, to see how seldom research is multi-disciplinary and how little - much less - research deals with recycling. CCR would like to address this

Currently, the CCR manage research projects in areas such as recycling of nickel metal hydride batteries, recycling of lithium ion batteries, recycling both manufacturing waste and end of life solar cells known as CIGS (copper, indium, gallium and selenium).

2.1 Recycling of NiMH batteries

The increasingly popular electric cars and electric hybrid cars contain a large amount of batteries of different types. We develop dedicated methods for the recycling of these batteries. The research on nickel metal hydride batteries includes characterization and dissolution and extraction of metals. The goal of this research is to develop methods to recycle all the material in the batteries, which would mean major environmental benefits. These methods should also be energy efficient and economically viable. Together with the battery manufacturer as ETC AB, we also investigate the possibilities to recycle batteries based on Li-jonteknologi in a still very newly started project.

2.2 Recycling of solar cells

Solar cells is an important part of the sustainable energy society. In cooperation with Midsummer AB, that produces solar cells of a type called CIGS. CIGS solar cells contain **c**opper, **i**ndium, **g**allium and **s**elenium. About half of these expensive chemical substances are now lost in manufacturing. Our research aims to develop methods to recover this waste production and to be able to recycle the material in the solar cells that are unsuccessful in their manufacture. These methods will also be used to recycle discarded CIGS.

2.3 Recycling of flat panel displays

Together with CIT Recycling, CCR is a part of a project dealing with recycling of flat panel displays, e.g. lcd-displays. The project aims to develop sustainable recycling processes for flat panel displays, new applications for the disposal and reuse of components and materials from the monitors and to develop guidelines for both the eco-design, eco-labeling and recommendations for future legislation.

2.4 Recycling of electronic waste (Waste Electrical and Electronic Equipment, WEEE) by microwave pyrolysis

The proportion of electronic waste (WEEE) in the waste stream is increasing and so is the proportion of electronic products on the market. One important point here is the rapid technological development, and the fact that these products have a short life. The current ways of dealing with that can be divided into three areas: waste prevention, recycling/reuse and expanded landfills. This project focuses on recycling of WEEE. The aim is to extract metals such as Cu, Au and Ag from the fractions of WEEE, currently going to landfill. The micro wave pyrolysis method was chosen because it provides advantages when it comes to control the pyrolysis process. The aim is to understand the complexities of the WEEE material response to the pyrolysis and to optimize the process.

We have now briefly presented the CCR's ongoing research. CCR hopes to develop and expand our centre and we also want to contribute to the development of multi-disciplinary

research. We believe that we have a great potential in these areas, and that these areas also need each other to be successful.