



## Asia Programme, final report for projects 2015-2017

### SUMMARY REPORT FOR PUBLICATION

<b>Name of the project</b> <b>Extractive metallurgy toolbox transfer</b>
<b>Coordinating Institution</b> Aalto University, School of Chemical Engineering

#### Objectives of the project (as indicated in the project proposal)

##### *End uses and users of the project*

We intend to deepen bilateral exchange in education and research in the metallurgical discipline. It expands the international impact of Aalto University and Central South University, and spreads the scope of extractive metallurgy courses as well as improves its research techniques in CSU. Another important purpose is to facilitate the Chinese metallurgical education and research by helping CSU to develop its extractive metallurgy discipline.

The outcome of this project was directed to the students and researchers in extractive metallurgy area of CSU. A significant improvement of CSU's professional education and scientific research level will be achieved through this venture. Further, the cooperation will also be useful on a long term in solving common industrial and environmental issues, and promote mutual academic activities.

The foremost aim of Aalto University in this project is to assist Central South University to improve its professional level of metallurgical education in the non-ferrous metals area by teacher exchange and scientific networking. The project manager of Aalto's side is Professor Taskinen supported by Ass. prof. Mari Lundström. They and their teams are in charge of providing an academic exchange platform for communication during the CSU co-operation. They will introduce a new extractive a metallurgy course to metallurgical students, and assist its development to an advanced problem based course of CSU during the CIMO project.

In our proposed project plan, CSU and Aalto will jointly supervise an excellent PhD student, who will defend his thesis at CSU in 2016, and train him to tutor of the new MSc course. The PhD candidate will carry out most of his theoretical studies for PhD degree in CSU. The joint experimental part of the degree project will be carried out in Aalto TDM group. The thesis will be accomplished according to academic rules of Aalto CHEM and CSU, as a set of scientific papers and compendium written about the findings received. Aalto thus explores possibilities to generate a joint PhD degree in this framework. The main objective of the joint PhD project is a transfer of new teaching methods to CSU, in the field of non-ferrous minerals and metals extraction. This will form a major societal impact of the project and significantly strengthens the capabilities of CSU to carry out world-class scientific research at high temperatures and support better its national responsibilities.

#### Achieved results and outcomes

Two permanent teachers of CSU are involved as formally responsible of the new MSc level course (Profs. Liu Zhihong and Yang Tianzu) as a part of curriculum of the School since Fall semester 2016. One PhD student (PhD Xia Longgong) and several other teachers (e.g. Liu Fupeng) has been trained in the procedures and methods of the new course at Aalto. Xia defended his thesis in November 2016 gaining joint CSU-Aalto PhD double degree and returned back to CSU.

Since Spring 2017, L. Xia has been appointed Ass. prof. of the CSU School and organiser of the new course.

### Activities carried out during the project

Completing the pilot-phase of the new problem-based course in Fall semester 2016 (for MSc and PhD levels education).

Including the new course as module in curriculum of School of Metallurgy and Environment at CSU.

Pilot course at CSU, October 2016.

Follow up and interim evaluation of the pilot phase quality and performance, Fall 2016.

The second phase and final form of the new course in Fall semester 2017 (MSc level, October).

Final evaluation of the new course, its learning outcomes and impact in November 2017.

### Future developments, resulting from the project

Results of the Aalto-CSU co-operation funded by CIMO were presented in several Journal papers and three scientific conferences, e.g.:

Longgong Xia (2015): Finland-Small with Landscale, Big in Innovation, *Journal of Hunan Education: Section D*, (12) 49-51 (in Chinese)

Xia L., Liu Z. & Taskinen P. (2017): The Determination of 3D Version Ternary Phase Diagrams of the  $\text{Cu}_x\text{O-ZnO-SiO}_2$ ,  $\text{Cu}_x\text{O-ZnO-CaO}$ , and  $\text{Cu}_x\text{O-ZnO-MgO}$  Systems, in: *Proc. EMC 2017 (Vol 3)*, June 25-28, Leipzig, Germany; GDMB, Clausthal-Zellerfeld, pp. 1211-1222.

Xia L., Liu Z. & Taskinen P. (2016): Experimental Determination of the Liquidus Surface of the Cu-O-ZnO-MgO System in Equilibrium with Air. A paper presented in *Copper 2016 Conference*, Kobe 12-16 October, (Paper PY15-4) pp. 997-1007.

Liu, F., Liu, Z., Li, Y., Wilson, B.P., Liu, Z., Zeng, L., Lundström, M. (2017): Recovery and separation of gallium (III) and germanium (IV) from zinc refinery residues: Part II: Solvent extraction, *Hydrometallurgy*, 171, 149-156.

Future actions:

One PhD double degree was accepted by Aalto and CSU (defense in November 2016) and 5 new PhD project start at Aalto University in 2017-2018 facilitated by the project.