Evaluation of the Research and Professional Activity of the Institutes of the Czech Academy of Sciences (CAS) for the period 2010–2014

Final Report on the Evaluation of the Institute

Name of the Institute: Institute of Chemical Process Fundamentals of the CAS, v. v. i.

Fields, in which the Institute registered its teams:

Earth and related environmental sciences

Observer representing the Academy Council of the CAS: Josef Lazar
Observer representing the Institute: Petr Klusoň, substitute observer Jaroslav Tihon

Commission No. 5: Earth and related environmental sciences
Chair: Prof. Dr. Franz Fiedler

Date(s) of the visit of the Institute: November 3, 2015
Programme of the visit of the Institute: see attached Minutes from the visit

Evaluated research teams:
No. 2 - Laboratory of Aerosols Chemistry and Physics; No. 6 - Environmental Process Engineering Laboratory

A. Evaluation of the Institute as a whole

B. Evaluation of the individual teams

Evaluation of the Team No. 2: Laboratory of Aerosols Chemistry and Physics

Report on the Laboratory of Aerosols Chemistry and Physics, Institute of Chemical Process Fundamentals of the CAS

1. **Introduction**

   The focus of scientific research is relatively broad, ranging from phenomenological topics to the quantitative behaviour of aerosols. The first group involves aerosols as cloud nucleation particles, their health effects, their chemical composition, their size distribution in regional and urban areas, and changes of their indoor composition and properties when having outdoor sources. The second group is connected to nanoparticles, their effects on adsorption in fluid systems and their influence on human health. Simulations of different molecular systems and surface interactions are under consideration.
   The team has reached a very good publication record, with three papers in the highest group, thirteen in group 2 and four papers in group 3.

   The age structure of the team is very well distributed with most of the members of age under 40. Only a very few are older than 50.

2. **Strengths and Opportunities**

   The team has a good connection to the universities and their educational programmes. All research activities involve students, especially PhD students, who contribute important results.

   Some of the projects are European funded projects; in addition funds are provided from Norwegian sources, which demonstrate good cooperation with researchers from this country. The strength of the research group lies in a good mixture of a few very experiencd persons with numerous young and very motivated scientists. From the numerous PhD students some will become integrated into the research group. The topics of the research are broad and the team's experience is sufficient in order to reach a significant exchange of knowledge in this field.

3. **Weaknesses and Threats**

   The cooperation with groups inside the CAS and at the universities should be improved, especially in field measurements in order to cover a wide area of conditions necessary for the interpretation of the findings. Joint modelling activities are encouraged.

4. **Recommendations**

   The team is on a good pathway of conducting their research. Field measurements (at the Earth's surface and from an instrumented tower) of aerosol distributions and changes of particle sizes, and their relation to the indoor aerosol distribution as a function of atmospheric conditions should be much more thoroughly investigated under controlled boundary layer structures (and for different wind directions), as a function of time and of regional sources, and in relation to human health and breathing problems. Developments with European modelling groups, in terms of modelling the evolving aerosol distributions, are to be encouraged. It may also be

worthwhile to try to measure the properties of even smaller particles and also the electrical charges on these aerosol particles of different sizes. If possible, participation in another large scale European funded programme would be most worthwhile.

5. **Detailed evaluations**

The strategy of the research plan for the future is a good extension of the work that has been followed successfully in the past. Some of the work should, however, be organized in joint studies with other groups from meteorology (e.g., with the Institute of Atmospheric Physics in Prague and, perhaps, the Global Change Institute in Brno), from general air pollution and also from modelling studies like deposition on different materials. Several groups working on a joint problem depending on a wide range of influences could merge into a larger observational field programme, and could also include related modelling studies.

The activities to study small particles which are of European interest (e.g., COST Action MP 1404) should be followed with great emphasis. This will help to solve problems of national interest.

Evaluation of the Team No. 6: Environmental Process Engineering Laboratory

Report on Environmental Process Engineering Laboratory, Institute of Chemical Process Fundamentals of the CAS

1. **Introduction**
   This quite large group of researchers uses novel techniques to solve a number of unrelated different practical (i.e. applied research) problems. These include:

   (i) clean combustion technologies (e.g., cleaning flue gases of mercury, burning sewage sludge, and treating ash from contaminated biomass),

   (ii) the recovery of valuable materials from waste (e.g., polyester materials [PET], materials on surplus electronic boards, and mercury from glass) in order to reuse them,

   (iii) the gasification of coal-biomass mixtures and slurries of different types, to produce a mixture of combustible gases for use in modern thermal power stations, and

   (iv) microwave technologies for the bulk heating of materials in an energy efficient way (e.g., tar for road repairs, and heating soil and building waste to remove persistent organic pollutants).

2. **Strengths and Opportunities**
   Several very practical problems are being worked on and solved. Members of staff collaborate with Institute staff in the Department of Analytical Material Chemistry. More than a dozen national patents have been granted – these might generate some income. Opportunities exist for further collaborations at both the national and international levels.

3. **Weaknesses and Threats**
   With so many different practical problems being tackled, it is hard to define the focus of the Laboratory's studies. The lack of sufficient funding for the wide range of ambitious studies being carried out is an ever present threat.

4. **Recommendations**
   The Laboratory should try to define about four major themes for its studies which should then act as a focus for the studies of the different teams involved. Whilst the Laboratory has a few links with international partner organisations, more international collaborators should be sought. In this way, more publications in high quality international journals should be achievable. It would be good to seek some funds from the European Union (e.g., Horizon 2020) and/or the European Research Council. It would also be good to try to obtain some international patents.

5. **Detailed evaluations**
   a) At present, the main research activities of the Laboratory relate to national, rather than international, issues. The quality of results published in the 17 papers which were evaluated was mixed; there were 8 papers in category 2 (good), 3 in category 3 (medium) and 6 in category 4 (rather poor).

b) The involvement of students in the research being carried out is good, with one PhD degree being awarded between 2010 and 2014, and 4 masters. Five students are now pursuing PhD studies – this is excellent and should be further encouraged. There are collaborations in teaching and research with five different Universities in the Czech Republic – this is to be praised.

c) The societal relevance of the studies being carried out is quite high – attempts are being made to reduce pollution when burning biomass to generate energy, for example. The mentoring of bright and ambitious students is applauded. Collaboration with the business sector in the Czech Republic is strong – this is most beneficial.

d) In the international context, the work planned for the future should be considerably strengthened. Many opportunities could exist for such extensions to the researches being carried out, and planned. There are also opportunities for increased collaborations at the national level.

e) Members of the Laboratory have an age distribution which is broad – that is good. A good number of staff members are aged between 30 and 35. The Laboratory is good at attracting young scientists to join. Thus the team's vitality and sustainability is very promising.

f) The Laboratory's plans for the future are sound, even though they are diverse. Research on lanthanates and phosphorus is being suggested by the Laboratory's staff. If such work is strongly relevant to the needs of society and also of a high scientific standard, this should be most worthwhile. A challenge for the future is to raise the standard of published papers, reducing the number of papers in category 4 and increasing the number in category 2, and to publish more papers in international journals with a high Impact Factor.

Date: December 28, 2015

Commission Chair: Prof. Dr. Franz Fiedler