WELCOME AND INTRODUCTORY REMARKS

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I have the great pleasure to open the Seminar on Material Behaviour and Physical Chemistry in Liquid Metal Systems and to welcome you cordially at Karlsruhe. The attendance list shows guests from the following countries:

Austria, Belgium, CSSR, Germany, France, India, Italy, Netherlands, Spain, United Kingdom, USA.

The idea to invite you to this seminar was nucleated by two local events: the replacement of the first German-built thermal reactor FR2 by the fast sodium-cooled reactor KNK II as a research tool, and secondly the completion of two sodium loops for material studies on the KfK-campus. The idea grew to critical size for a positive decision by the encouragement given to us by many of you. This external impetus certainly is due to the facts that liquid metal technology is in fast development and such a meeting, which concentrates on the materials behaviour, will be valuable in offering to the research man or manager a timely chance to gain a representative overview on the state of the art. Having this in mind we intended to avoid parallel sessions. This could not be fully reached; however, the programme committee did its best to minimize the problem of overlapping themes.

There is no question that the liquid metal community can look upon its achievements within the last decade with pride. On the much disputed energy field liquid metal use is a technical reality and, in addition, offers bright outlooks into new and challenging applications. Mention should be made here of the fusion reactor, of the so-called topping cycles in thermal power stations and of intense neutron sources.
Allow me now, as a critical admirer of liquid metal technology, to make some rather sketchy comments on a selection of liquid metal fields. To begin with sodium it may stated that liquid sodium technology is more advanced than our basic knowledge of thermodynamic and kinetic aspects of alloy and compound formation. Thus, systematization of phase relations (phase diagrams, existence diagrams) of multinary systems especially with non-metals appears to be a rewarding task in the near future. This certainly also holds for the improvement of corrosion models allowing even more reliable calculations on LMFBR fuel elements. To further promote the reliability and safety of sodium cooling, the influence of impurity elements on the mechanical properties of reference (and of alternative) materials has to be studied. This, of course, should include fracture mechanics methods like crack propagation under fatigue and creep loadings of base and welded material.

Turning to lithium it may be remarked that it forms binary compounds with approximately the same number of other elements as does sodium (~30). This tie is reflected in the equal number of papers on lithium and sodium physical chemistry aspects at this seminar. Liquid lithium is a technological newcomer and therefore quantitative corrosion data (as reaction rates or solubilities) are still sparse. However, it appears that at this seminar remarkable progress will be seen in this field. The technological interest in liquid lithium is centered in the fusion field. However, it seems that liquid lithium as a coolant and breeder substance is not only challenged by the combination of He-cooling plus solid breeder, but also by highly alloyed liquid lithium. The designers of fusion reactor systems - be it Tokamak-, Mirror- or Inertia-Type - appear to prefer Pb-Li eutectics: Pb\textsubscript{38}Li\textsubscript{62} (95 Wt-% Pb) or Pb\textsubscript{82}Li\textsubscript{17} (99.3 Wt-% Pb). The advantages are to be found in the neutron multiplication effect of Pb and in two safety-related aspects: the relatively weak reaction with water and the low active tritium inventory in such a blanket. The compatibility between those liquid Pb-Li-alloys and prospective structural materials (austenitics or martensitic 9-12 % chromium steels) remains to be established, however.

A modern application of pure lead (or of a lead-bismuth alloy) will possibly be the liquid metal target of the so-called Spallation Source. In this device high energy protons (600 MeV) split up target atoms, producing a high density neutron beam. The liquid metal target will be heated up to about 450 °C, which may lead to compatibility problems with the structural materials.

Returning to alkali metals, the intention of improving the efficiency of thermal power stations to over 50 % with the help of potassium deserves mentioning. Potassium possesses a boiling point (775 °C) which is lower than that of sodium and is therefore