## Cooperation

### Nuclear research institute, Rez plc, Czech Republic,

Ustav jadernogo vyzkumu Rez, central analyticka laborator Research Center, Ltd. , CZ-25068, Czech republic
Institute of Inorganic Chemistry

### AGREEMENT OF CO-COOPERATION, 2000-05

Taking into consideration the previous scientific and technical co-operation between the Nuclear Institute Rez and the Moscow State University, the following agreement on co-operation has been signed.
Partners of the agreement
1. The Department of Radiochemistry Moscow State University, Moscow, Russia represented by the head og the Department Prof.V.M. Fedoseev, DrSc.
2. The Central Analytical Laboratory Nuclear Research Institute REz, Chech Republic represented by Dr.Z.Malek, CSc., the head of the Laboratory

Subject of the agreement

The subject of the agreement is the co-operation between the Department of Radiochemistry, Moscow State University, Moscow, and the Central Analytical Laboratory, Nuclear Institute Rez (Chech Republic) in the field of use the radionuclides in the research of materials and environmemt. The exchange of expert between the parties is envisaged. The number of visits and their duration will be agreed according to the needs of the work. During the exchange of experts the inviting part will pay the accomodation and per diem for the experts of the invited part as well as their travel cost from Moscow to Prague and back. This agreement is scheduled for 5 years starting from May, 2000.

### CONTRACT
### on creation consent to use and to distribute the mathematical modelling product, closed in accordance with Copyright law, 1995

Nuclear Research Institute Rez plc, 250 68 Rez near Prague ICO 215207, represented by Dr. D.Morkovin, Administrative director and Professor Igor Nikolajevich Bekman, born 7.7.1941 closed the contract to use and to distribute Author's copyright property the product under the following conditions:

1. The NRI and Author of the product have agreed that the object of the contract is: Development of a mathematical model of radon (and radium) migration in porous media, formed in the concrete crack under presence of Ca-hydrocarbonate solution (in dynamic conditions of the solution flow).

2. Product is created at the NRI expenses. Specification of the Product, check-up of its creation process and delivery deadlines are controlled by NRI instructions and the Author is aware of the fact that the NRI can use the Product for the purposes of its tasks, related to its scope of activities, without any special Author's consent. Righ and responsibilities following from this contract shall pass to the rightful successors (heirs) of parties.

### GSF Forschung fur Umwelt und Gesundheit GmbH
### GSF- National Research Center for Environment and Health
### Institut fur Okologische Chemie
### GSF - Institute of environmental chemistry

Postfacht 1129, D-85758 Neuherberg Professor Dr. A. Kettrup and Dr. Georg Matuschek, Institut fur Okologische Chemie, GSF-Forschungszentrum fur Umwelt und Gesundheit GmbH matuschek@gsf.de

## Plan

**of activities in Federal republic of Germany by Prof. Dr.I.N.Bekman, Moscow State University, Chemical faculty**

1. Mastering of new thermal analysis methods for determination of the environmental impact of industrial products during production, use, recycling and waste management.

2. Characterisation of thermal behavior of polluted clay minerals samples (namely bentonite as a soil component contaminated with dichlorphenol, aromatic complex phenolic acids, quarternary amines as degradation products of herbicides etc.) using the DTA/TG coupled with Mass Spectrometry.

3. Methods for data acquisition.

**Project GSF-MSU**

**Short Title: Optimisations of organic/inorganic polymers incineration**

**Full Title: Optimisation of the incineration process of organic polymers containing inorganic substances**

1. Objectives of the Project

Aim of research are:

1) Life cycle analysis and environmental risk production assessment of silicon polymers for membranes and related materials.

2) Determination of the conditions for pyrolysis and thermodestruction of organic polymers containing inorganic substances (Si, Ge, Sn). Analysis of the evolved gases.

3) Use of adsorption active filters with planar sorbents and membrane absorption of hazardous components in order to achieve a more efficient separation of hazardous volatile from the effluent gases resulting after incineration. Testing of active filters using German and European Standards.

4) the optimization of the incineration process of silicon and other elements containing polymers, used as, varnish, lacquer, glue, binders, hermetic, heat insulator of spacecraft, refrigerator buildings materials, coatings of gas and oil lines, wire and cable, membrane materials and another organic/inorganic polymers used recently in the Russian Federation and other countries.

5) Practical recommendation for the complete utilization of organic polymers containing inorganic substances in industrial waste processing, in particular, for transformation of organic parts of polymers into petrochemical-like substances and transformation of the silicon residuals into high-porous adsorbents, will be transferred to the incineration plants and potential users both in the Russian Federation and Germany.

2. Working program and time schedule

1. Life cycle analysis and environmental risk production assessment of silicon polymers for membranes and related materials Collection of polymer waste sample in various places in Russia and Germany. Chemical analysis of the collected samples. Characterisation of thermal stability of silicon polymer waste.

2. Investigation of oxygenate pyrolysis and thermodestruction of organic polymers containing inorganic substances. Following materials will be investigated: polysiloxane, halogen and silicon-containing carbochain polymers, random and block copolymers, fluoroilicone polymers. Determination of optimal conditions for burning of the silicon containing polymers. Use of the new planar sorbents and the regular structure apparatus (adsorption active filters) for separation effluent gases of the incineration process from hazardous pollutants.

3. Development of recycling methods of complete utilisation of Si-containing polymer waste, in particular, transformation of organic parts of polymers into petrochemical-like substances and transformation of the silicon residuals into high-porous adsorbents. Practical recommendation for the complete utilisation of organic polymers containing inorganic substances in industrial waste processing. Organization of joint workshop. Results will be transferred to the incineration plants and potential users petrochemical substances and sorbents in both countries.

4. Preparation of final reports and manuscripts of publications to journals

5. Exchange of Scientists

3. Task sharing

3.1 German Partner

Develop optimal methods for incineration polymeric waste containing inorganic substances. In particular, it concerns silicon-organic polymers for industrial application and selective Si-organic-based membranes. Thermal Analysis characterisation of the Si-containing polymers will be carried out by means of DTA, TG, EGA/MS. The GSF laboratory is well equipped for this task. The German partner will also participate in the dissemination of the results and practical use of the incineration process of Si-containing polymer waste to potential German users.

3.2 Russian partner

Development of phenomenological theory of kinetics of thermodestruction of Si-organical polymers. Mathematical simulation of gas evolution from polymers during heating. Development of methods of transformation of the silicon-organic polymers of various composition, structure, and industrial application into high-porous adsorbents. Testing sorption properties of porous products of thermodestruction Si-containing polymers and surface area determination. Separation of gaseous products of polymers decomposition using advanced membrane absorbers. Use of the basaltic fibrous sorbents and the regular structure apparatus (adsorption active filters) for cleaning flue gas of the incineration process from hazardous pollutants

4. Rationale

Moscow State University study of thermostability of selectively membranes (silicone polymers, organo-mineral membranes, organic/inorganic hybrid membranes) used in Russian industry for separation of gas-gas, gas-liquid or liquid mixtures. Following materials used for polymer membrane production in Russian Federation will be considered in the project: polydimetylsiloxane, polytrimethylsilylpropine, polyviniltrimetilsilane, block-copolymers (polyarylate-polydimethylsiloxane, polyviniltrimethylsilane-polydimethylsiloxane), plasticized polymers (polyviniltrimethylsilane (PVTMS) oligovinyltrimetrimethylsilane, PVTMS-oligovinyloctyldimethylsilane, PVTMS-dioctylsebacinate); organo-mineral membranes (polymers and ceramics material), e.g. polysulfone+ZrO2, organic/inorganic hybrid membranes (porous inorganic membranes with grafted or trapped organic species, nanoscale ceramic/polymer composites, organic/inorganic hybrid polymers). Materials used in coatings (fluoroalcylsilane based systems, silicone grease, silicon rubber, etc.) will be investigation. The project will be used for the introduction of life cycle management of silicon polymer waste from automobile and building industry in the Russian Federation and Bavaria. Investigation of processes pyrolysis and testing pyrolyses products from the view-point of their toxicity as well as and solid residues will be carried out by means of methods available at MSU and GSF, respectively. Information about methods of complete utilisation of Si-containing polymers will be used in the production and subsequent treatments polymer materials. The results will be dissemination to potential users both in the Russian Federation and Germany. A joint workshop will be organises in the third year of the project.

**Projekt: CHEMICAL TREATMENT OF COAL FLY ASH WASRE YIELDING ZEOLITES USABLE AS SORBENTS OF ENVIRONMENTAL POLLUTANS, 1997-1999**

Project Coordinator: Dr. Georg Matuschek GSF Forschung fur Umwelt und Gesundheit Prof. I.N.Bekman, MSU, Moscow Dr. J.Dzelme, University Riga

Thermal behavior of spent zeolite during burning of organic pollutants will be tested. Following equipment will be used: IR-VIS spectroscopy, DTA, TG, instrumental analytical methods, AAS, chromatography etc.

Bekman: Modelling of processes taking place during treatment of the fly ashes and sorbents. Mathematical modelling of the hydrothermal processes used for transformation of fly ash into porous zeolite materials aiming to determine optimal conditions of the treatment giving

maximal porosity and sorption ability of the sorbent. Computer treatment of experimental results obtained during hydrithermal treatment of fly ash samples. Modelling of the effect of pH, solid/liquid ratio and temperature on the properties of the zeolites. Computer treatment of the experimental data of sorption-desorption processes, using heavy metals, ammonia and organic compounds. Determination of adsorption isotherm types. Computer treatment of the experimental data of Emanation Thermal Analysis characterizing changes in the porous system of sorbents. Recomendations for the construction units for the treatment of liquid waste (Industrial waste and agricultural waste).

Dzelme: Characterization of the sorption behavior of the zeolites to volatile pollutants using thermodesorption spectroscopy. Supplying a sample of the fly ash from the power plant in Baltic republic to the ICT Praha. The equipment for characterization of sorption-desorption of gases is available at the Institute of Chemical Physics.

**Universitet van Stellebosch, Institute for Polymer Science**

R.D. Sanderson - director

Dmitry G. Bessarabov, Ph.D.

Universitet van Stellebosch, Institute for Polymer Science, Hydrocarbons Separation and Electro-Separations group, Project Leader, Stellenbosch, South Arica

**University of Delaware, Chemistry and Biochemistry, Brown Laboratory, Newark, Delaware, USA**

Andrew V.Teplyakov, Ph.D. Assistant Professor, Physical Chemistry, University of Delaware, Chemistry and Biochemistry, Brown Laboratory, Newark, Delaware http://www.udel.edu/chem/teplyakov.htm

**UNIVERSITY OF HERTFORDSHIRE**

University of Hertfordshire, Hatfield Campus, College Lane, Hatfield Herts, AL109AB
25 February 1993

Dear Professor Beckman

Your letter of 11 January 1993 reached me at the beginning of Februrary 1993. It is with great pleasure that I now write to accept your kind invitation. I shall travel to Moscow on 20 April 1993 and shall be available for seminars and lectures in that week. I look forward to our exchange of ideas and learning in the areas of Advanced Manufacturing Technology (AMN) and Surface Mount Technology (SMT). I would hope that this link shall prove fruitful to both partners and look forward with anticipation.

Yours sincerely.

Moyra Fowler, Lecturer,

Manufacturing Systems Engeneering.

8 September 1993

Dear Professor Beckman

Further to my letter dated 12 May 1993 I would like to advise you of progress made. Having submitted details of your work in the area of Environmental Science to our own Environmental faculty a discussion of further detail followed. Our own faculty currently has extensive International links and already receives students from the former Soviet Union. I advised them of your participation in field studies and was told that funding and staff had already been allocated to joint international studies for the foreseeable future. My investigation into the possibility of funding for a course in Englisch for students from the FGU has not revealed any sources. I was unable to find a course specifically for Russian speakers. The Division of Chemistry has fully employed all the current funding under agreement with the Academy of Sciences. However, should funding become available under the International Exchange agreement for this academic year, 1993/1994, the Division would process an application from yourself. If you complete the relevant section of the application and return the form to me at

Hertfordshire, this would allow the Chemistry Division to build a suitable programme around a proposed visit.