

## INFORMATION

### THE USA–ESTONIAN CO-OPERATION IN OIL SHALE RESEARCH AND UTILIZATION

After one year of preparatory work, with participation from the US Department of Energy, Ministry of Economic Affairs of the Republic of Estonia, Embassy of Estonia in the USA and the Estonian Academy of Sciences, on 4 February 2000, the USA Energy Secretary B. Richardson and the Minister of Economic Affairs of the Republic of Estonia M. Pärnoja signed the scientific-technical co-operation agreement on research and utilization of oil shale.

The objective of the agreement was:

- To promote co-operation in research and utilization of oil shale, attractive to both sides.
- To work out commercially feasible processes for production of high-value oil and chemical products from Estonian and American oil shale.
- To exchange technical information and to carry out expert examination regarding the opportunities to enhance the efficacy of available processes and to obtain prospective oil products.
- To contribute to the energy security of both parties, to development of the market of oil shale products and to improvement of environment.
- To create a respective network for implementation of co-operation.

The agreement specified in greater detail the areas and forms of co-operation, structure of administration of co-operation, conditions of information, equipment and personnel exchange, tasks of protection of intellectual property and confidentiality. The funds attracted to co-operation were supposed to be employed in full compliance with the job tasks stipulated in the agreement, with the respective responsibility vested in the party using those funds. The agreement was made for the period of three years. For the purpose of co-ordination of the co-operation, for the stage-wise planning and estimate of the work performed, a common co-ordination committee was set up, with four representatives from both parties. Co-chairmen of the committee were Anton R. Dammer of the US Department of Energy and Kitty Kubo of the Ministry of Economic Affairs of Estonia. Programme Operating Manager was Professor Jüri Soone, Operating Co-ordinator Ph.D. Mihkel Koel.

Estonian Academy of Sciences was vested with the responsibility to gear up the programme, to design the topical plan, to assign the senior executives of the topics, to make propositions for allocation of the funding, and also for setting up of the technical expert commission. Later, the fulfilment of the

said tasks was mostly transferred to Tallinn Technical University, as approved by the programme co-ordination committee. The programme was launched in April 2000.

The programme was phased – temporally into three stages, each one year long; topically, the programme covered four areas related to extraction of shale oil and chemicals:

- I. Value-added processes and products
- II. Boosting the efficacy of production
- III. Research for environment protection
- IV. Innovation and new concepts

In every area there were up to five research tasks.

Experts from both parties estimated the results periodically. Then the results were discussed with the members of the co-ordination committee. The accents of the next stage depended, to a great extent, on the outcome of the previous stage. The sessions of the joint co-ordination committee were held at least once per year, in Tallinn as a rule, once also in Washington D.C.

Executing agencies of the programme came mainly from Tallinn Technical University (incl. Oil Shale Institute, the former Institute of Chemistry, and Institute of Energetics), less so from University of Tartu. There was some co-operation with enterprises – Viru Keemia Grupp (Viru Chemistry Group), Narva Elektriijaamad (Narva Power Plants), Carboshale and James W. Bunker & Associates, Inc. (USA).

The programme was financed from the USA state budget with the co-funding from the Republic of Estonia, mainly to modernise the infrastructure. This was the largest investment into the Estonian science, injected under a bilateral agreement between states.

In what follows is the synopsis of the main results of the programme:

1. Composed was a systematic survey and analysis of the research and technological practice related to processing the Estonian oil shale. Carried out were comparative studies on composition of shale oil and solid waste yielded by two different technologies (vertical retorts in Viru Chemistry Group and the solid heat carrier in Estonian Power Plant).
2. Tested in laboratory conditions and worked out was a new refinement scheme of shale oil, basing on extraction process, for separation of phenols and neutral oxygen compounds. The research in hydrogenation of residual raffinate (hydrocarbons etc.), gas and gas-naphtha added assurance that it is possible to improve the quality of the oil shale fuel oil, and to obtain quality additives to gasoline and diesel fuel.
3. Worked out were methods for obtaining new chemical products – the light and thermo stabilizers to rubber industry, the biocides to building materials, colouring agents and lacquers, which, complementing the substances (resins, glues, tanning agents etc.) obtained on the basis of water-soluble phenols by earlier development works, would allow widening of the product range.

4. Worked out was the scheme of comprehensive and complex processing of shale oil, consisting in splitting the crude oil into two components, by means of extraction – into a hydrocarbon component for its further processing (i.e. for hydrogenation) with the aim of obtaining quality liquid fuels, and into the component containing oxygen compounds, with the aim of producing chemical products, using residual gas for production of electrical or thermal energy. Presented were the instrumentation of the process and the material balance of respective industrial production (with capacity of 0.3 and 1.0 million tons of shale oil annually), orienting partly to the standard equipment used in petrochemistry.
5. Researched and made were new technological propositions for better purification of wastewater, in the first place with the view to minimizing the content of phenols and nitrogen compounds.
6. Worked out were the recommendations for handling the semicoke, and fussels both by burning them in boilers and by improvement of storage methods.
7. Worked out and introduced was the modern procedure for confidentiality to be observed by participants in the programme and for protection of intellectual property to new process designs, also for patenting the new products.
8. Made were the propositions for doing further research and carrying out development works on industrial pilot equipment, specifying the extent and conditions of selective separation and hydrogenation of shale oil, promoting elaboration of new products on the basis of phenols and neutral oxygen compounds, continuing respective market research, boosting the working out of new retorting facilities of higher efficiency. In view of the limited resources of liquid fuels, and the price increase in world market, highlighted was the need in Estonia to shift the emphasis to technological processing of oil shale and to press forward the international co-operation.

The programme gave new vigour to research in oil shale, having in the meanwhile ground almost to a standstill, and created the makings for emergence of a new generation of oil shale scientists, for critical business-like deliberations in the estimate of the results, and for planning the follow-up work.

The second international oil shale conference held in Tallinn in 2002 gained much of its prominence due to the co-operation carried out within the framework of the programme. The results of the common research work were duly appreciated at the representative conference held in Washington in 2004 “The strategic importance to America of oil shale”, adopting the resolution to develop the USA state programme plan, notably “to push the oil shale to the frontline of energy policy”.

The volume of shale oil production in Estonia has reached 350 000 t annually, of which nearly 50% is exported. By adding fuel gas and

chemicals, the aggregate value of products amounts to EEK 1 billion annually. The steep rise in prices of oil products and improvement of efficiency of production will create prerequisites for the impressive growth of profit margin.

The members of steering committee of the programme find that the USA–Estonia oil shale co-operation must be continued, focused on technological development and new technologies, economically motivated and commercially profitable production, with R&D institutions involved in co-operation with enterprises. The existing draft programme of preliminary nature will now be tackled by both partners of the programme, in all earnest, however under condition that the Governments of both states will declare their whole-hearted support to the new programme. Furthermore, the USA party contemplates setting up of an international consortium of oil shale research and development works, with the states possessing the oil shale deposits and the relevant companies participating, including Estonia as the country with the longest background of research work and the most impressive record of technological experience.

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