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IN THIS ISSUE:

MESSAGE FROM NEIL B. GODICK

Russia is facing a severe labor shortage. The shortage is present at all levels - from laborers to senior managers, including executives.

This labor shortage is exasperated by:

- a shrinking work force.
- unfriendly immigration laws
- a tradition of inefficient and unproductive work force
- significant inflation from an abundance of oil revenues
- long delayed infrastructure improvements budgeted at $570 billion

The labor shortage coupled with these factors will hurt, and perhaps curtail, the current economic boom.

According to Russia's State Statistics Service, in the first four months of this year, compared to 2007, the work force shrunk by 300,000. Estimates are that the country's work force will shrink by 8 million over the next seven years and by up to 19 million by 2025.

In a study of Russia's work force, 75% of the respondents under 35 said they were ready to emigrate. Newspapers report increasing numbers of highly skilled Russian professionals returning – that's just not true. This study supports that the brain drain continues.

The average age of the working population is rising, currently 39.5 years. It is expected that Russia's low retirement age, 55 for women, and 60 for men, will have to be increased.

We do not intend for these reports to solve any need our readers may have. We do intend to keep everyone current on technology developments in Russia. If you would like any additional information on any of the developments reported – send us a note.

Physics – Temperature Measurement

Russian scientists have developed and patented a Z-thermistor - a unique thermosensitive element. The accuracy of temperature measurements, low power consumption, unique functionality and small dimensions open wide, almost boundless, prospects for

application for this technology.

The Z-thermistor's key component is a semi-conductor n-p structure. The authors have not disclosed details of the composition, processing technique or structure configuration. The thermistor itself has been patented in Russia, Europe, China and the US.

The essence of this technology is: the structure, depending on the temperature, is capable of passing from one steady state with low current to another steady state with a high current. To set the temperature at which the thermoelement will switch states, requires only changing the supply voltage. Therefore the thermistors can be considered as tunable temperature indicators. Accordingly, in response to a change in the supply voltage, the temperature threshold at which there is a current jump will also change. The amplitude of the current change is great enough that external amplification of the signal is not necessary.

The wide useful range of temperature detection (-40 °C to +120 °C) opens the scope of the thermistor application to residential, industrial or warehouse heating systems, automobile interiors, airplane cabins, engines, brake systems, fire alarm systems, all kinds of greenhouses, and even oncological diagnostics. The Z-sensors are very sensitive elements with technical capabilities (in terms of the simplicity of design and control, sensitivity, compactness, and universality. The cost for these sensors is less than currently used temperature sensors.

A unique application for the Z-thermistor is thermodiagnostics for oncological diseases. The thermistors is the base of a device that is simpler and less expensive than the currently known thermal imagers. The device by IR signal changes, can remotely detect higher temperature areas on the patient's body surface. The temperature readings over the area of neoplasms are somewhat higher – by approximately 0.5-1.5°C.

Solar Cells

At the A.F. Ioffe Physicotechnical Institute, nanotechnologies were used to develop new types of cascade solar cells. These new cells ensure an efficiency of more than 35% at 1000-fold concentration of solar radiation. Based on these elements and inexpensive Fresnel lenses concentrator photo-electric modules and solar power plants were developed. These modules are promising for supplying electric power to independent consumers.

Space Detection Technique

Scientists from the *Diagnostics and Technosphere Safety* section of the Russian Academy of Natural Sciences (Moscow) have developed a detection technique using photographs taken from space. This technique is used to detect defects in oil pipelines. With this technology underground oil pipelines and defects in the pipeline can be identified. The technology is able to identify those sections of the ground which can provoke defects (so-called corrosion-active sites).

Moreover, processing the images allowed analysis of vegetation and terrain in the oil pipeline area. The technology is able to distinguish and identify objects of natural and artificial origin.

To verify their approach the authors used an independent expert for an appraisal – they checked the pipeline's actual status by physically inspecting, on land, the same pipeline sections. In all of the spectral bands used, the oil pipeline was very well "seen". "Delectability" was never less than 90. There were some deviations from the space-photo data to ground inspection. Those deviations were insignificant. Now the authors are trying to determine the reasons for them and working on making the space diagnostics even more exact.

For non-specialists, the possibility of seeing *something that is underground* from a satellite seems improbable. However, professionals know that radiation in the radio frequency range can help in detection. Against the general background of terrestrial radiation sites with atypical inclusions can be detected. For example, metal pipes filled with a substance that, in terms of its physical properties, essentially differs from the ground is detectable

Coating - Nanodiamonds

A team of physicists from several institutes in Moscow and near Moscow are developing the process for producing a new composite material with a diamond matrix.

Currently, to produce a diamond coating for process tools, microcrystalline diamond powders are used. It is also possible to use detonation nanodiamonds. Their hardness is comparable with that of monocrystals using natural diamonds. The diamond coat can be obtained by sintering nanoparticles. To obtain a hyperfine coating with appropriate mechanical properties, an activating additive is necessary. For this role the scientists have chosen cobalt which is typically used for producing double-layer diamond-carbide plates. The material is obtained by sintering the nanodiamonds with cobalt at high pressure and temperature.

Nanodiamonds are polycrystalline particles with a size no more than two tens of a micrometer. Nanodiamonds and cobalt were placed in a high pressure chamber and, at 8 GPa, the reagents were heated at a fixed rate to a temperature of 1700—1800 K, at which the cobalt melted and flowed into the diamond filling up the cavities. In the experiments use was made of nanodiamond polycrystalline powder with aggregations (polycrystals) sized 3—4 microns and the crystal grains within them sized 10-20 nanometers. The sintering process lasted less than 10 seconds.

In the presence of cobalt, which played the role of catalyst, nanodiamonds are effectively recrystallized to form a rigid diamond skeleton. The microhardness of the composite material depends on the concentration of cobalt in it. To produce strong and hard

composite materials, the concentration of cobalt should not be less than 3-4 volume percent. The peak hardness of the sample (up to 80 GPa), comparable with the hardness of diamond monocrystals, is reached in the area with a cobalt concentration of 6-8 volume percent.

Automobile Oil Filter

Specialists of DK-Techno, a Russian research-and-production enterprise, have developed an original oil filter for the automobile engine. According to *Infromnauka, the* authors named their development "Hurricane".

The basic, but not the only feature of the new filter is a powerful ring magnet for protecting friction parts of the engine from wear that may be caused by mechanical impurities, including all kinds of metal particles. It is the magnet that extracts all metal particles from the oil flow. And for convenience and the maximum completeness of their extraction, the oil flow also rotates (twists) by a special – tangential – arrangement of the openings through which oil enters the filter.

According to authors, in addition to the magnet removing metal it firmly grips and retains the “captured” particles that contaminate oil. Special protective screens located round the filtration element do not allow the oil flow to wash off the impurities filtered earlier, thereby reliably protecting the engine.

In situations where the filter is already clogged and it is not possible to immediately replace it, the authors have provided a special pressure-relief valve. It works only in extreme conditions of "oil starvation” when the system pressure is 0.6-0.8 atm. This valve lets the oil, which has been cleaned by the magnet only, directly into the engine oil duct. Of course, this can be considered only a palliative, but sometimes a bad solution is better than complete stoppage. And when the car will reach a car repair shop, the mechanics there will be able to replace or wash the filter.