FREE PGNA

ONLINE RAW MATERIAL COMPOSITION ANALYSER

Project Initiator Company – Libre Evolucion de Energia S.L. (Spain, Free-Libre.com)

Libre Evolucion de Energia S.L. as a technology company is engaged in the industrial innovation development and application.

The Company invests its own and investment fund (partner) resources in it.

Range of business interests of Libre Evolucion de Energia S.L. encompasses:

❑ alternative energy sources

❑ photosynthesis

❑ oil and gas industry

❑ PGNA-based analyzers

❑ cement production

❑ composite building bars

Partners of Libre Evolucion de Energia S.L. :

Malaga University of Technology (UMA)

Ciemat

Centre for the Development of Industrial Technology (CDTI)

Bekar Europe

Cepsa

SYC Laboratorio Electromedicina

Vorga Steklokompozit (Fiber-Glass Composite) Manufacturing Plant

Project Developer Company – RATEK R&D Center

RATEK was founded in 1991 for the purpose of commercialization of Russian inventions in the field of nuclear physics. Staff number is 52 persons.

RATEK business areas:

❑ development and application of explosive, radioactive and fissile material detectors;

❑ development and application of new industrial technology solutions for elemental composition control (raw material control in the cement production; coal, oil and ore control, etc.).

RATEK has all necessary authorizations and certificates for the development, use and production of:

▪ gamma and neutron sources;

▪ radioactive material measurement and control;

▪ detectors and high-speed electronics.

RATEK major projects:

Participation in the Federal Special-Purpose Programme "Anti-Terror" and "Traffic Safety" (Federal Security Service of the Russian Federation)

Installation of radiation monitoring systems at the facilities of Russian Railways, underground, airports

Installation of explosives detection equipment at the facilities of Federal Air Transport Agency and Federal Security Service of the Russian Federation

Livermore National Laboratory

❑ 2002 - UVP-5101 unit testing

US Department of Homeland Security

❑ 2010 – Spectroscopic radiation control display testing

World Bank Headquarters in Washington

❑ 2011 – supply of the incoming mail radiation monitoring system

**Uzbekistan airports (2009-2010, 2016), Kazakhstan railway stations (2015), UAE dedicated facilities (2016)**

❑ Installation of human and traffic radiation monitoring systems

Republic of Lithuania

❑ Installation of human and traffic radiation monitoring systems

People's Republic of China, **government procurement contracts:**

❑ 2008 – Explosive detectors for carry-on baggage
❑ 2010 – Liquid detection system
❑ 2014 – Through-the-wall explosive detectors
❑ 2015-2016 – Mobile explosive detectors
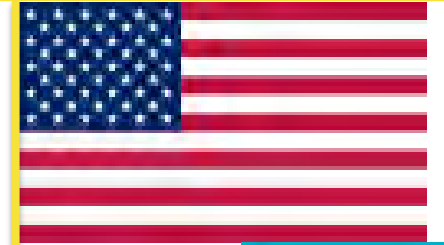
Project product is FREE PGNA, an online analyzer of cement raw materials based on the <u>neutron activation analysis</u>

❑ Ensures the continuous non-contact analysis of cement raw materials with the display of composition information;

❑ Used in the automated process flow management system to correct and optimize the cement raw material composition on a real-time basis;

❑ Measurement accuracy – not more than 10% at the mix moisture content up to 23%;

❑ Has a built-in temperature stabilization system;

❑ Enables to optimize the raw material utilization, reduce the production costs and save energy.

Operating principle:

❑ A neutron source (2.35 MeV) irradiates an object with a neutron flux;

❑ Neutron-irradiate elements emit secondary gamma radiation registered by gamma detectors;

❑ Gamma radiation range allows to determine the composition and percentage content of each element.

Operating peculiarities:

1. The neutron source (Cf-252 source or neutron generator) is required;

2. Biological protection is required.

Location: downstream of the raw mixture formulation site and upstream of the drier-crusher.

Purpose of analysis: generate the information for the Production Management Centre to decide on the raw mixture correction
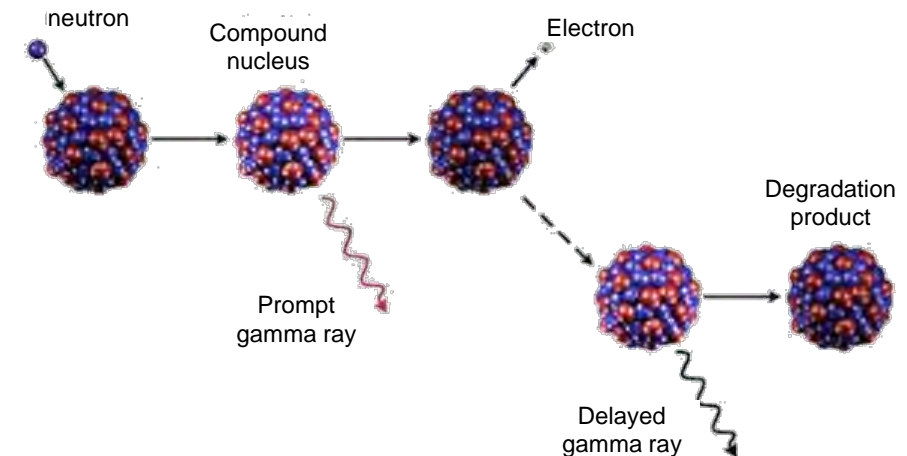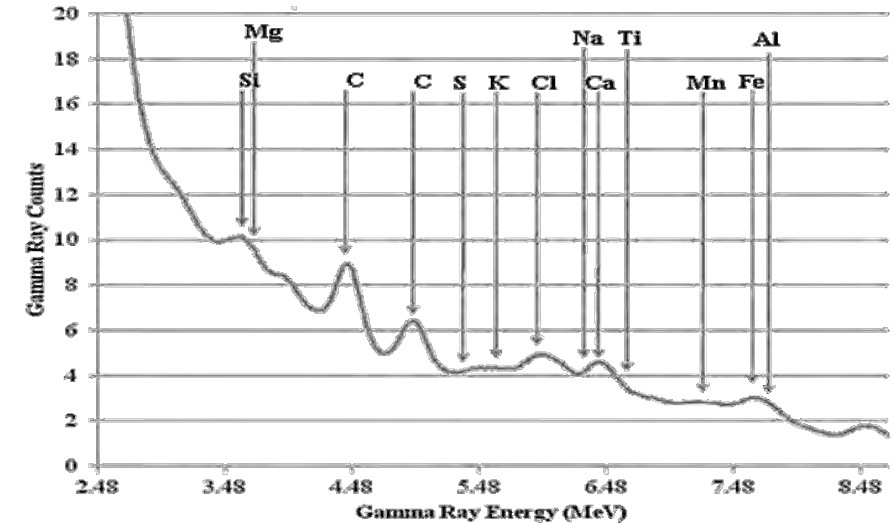
Continuous analyser composition:

The analyser consists of the **software** and **hardware**, made of the following major components:

1. Detector unit *(is made as the frame structure protecting from the radiation)*;

2. Neutron source 252Cf *(stainless steel body, with a one-way radiation directed at the measuring area)*;

3. Detector *(designed to detect gamma radiation generated by the neutron activation of material)*;

4. Signal processing unit *(processes the detector signal and divides it into spectral components)*;

5. Main unit *(designed to analyse the gamma ray spectrum generated by the signal processing unit. It calculates the content of various elements and other related parameters to control the cement manufacturing quality)*.

Technical parameters of FREE PGNA:

Parameter	Value
Conveyor belt width	500 to 1600 mm
Neutron source	30-60 µkg, 252Cf
Ambient temperature	-40 to +60°C
Power voltage	220 VAC 50 Hz, 6A
Oxide content determination	SiO2,Al2O3, Fe2O3, CaO, MgO, K2O, Na2O, SO3, TiO3
Determination of quality parameters	KH, SM, IM, C3S, C2S, C3A, C4AF etc.

❑ The radiation detector by the world leading manufacturer is used in FREE PGNA

❑ The radiation protection system ensures that the radioactive background around the device is lower than in other similar devices.

Neutron analysis method advantages:

❑ The neutron analysis works at the level of neutron content of substance and ensures the continuity;

❑ The neutron analysis provides for the accurate measurement of elemental material composition without the effect of particle size or mineralogy (any form, size, composition);

❑ The penetrating nature of neutrons and gamma radiation provides for almost ideal uniformity of sensitivity along the whole sample, regardless of the material particle size;

❑ The real-time (online) data provides for the rapid process management by tracking the value of certain element and necessary calculation parameters;

❑ Operation stability and accuracy.

Sampling method disadvantages comparative to the neutron analysis method:

❑ Round-the-clock laboratory monitoring of material composition in real time is impossible;

❑ Periodic measurements of material characteristics may not show essential changes in material composition;

❑ Average long-term data with delayed acquisition cannot be used for the prompt process flow management;

❑ The individual sample analysis accuracy is of less importance than the real-time data in the neutron analysis.

Comparison between the **FREE PGNA** analyzer and **OMNI** – the market leader and major competitor device

Parameter	FREE PGNA analyser (RATEK)	OMNI analyser (THERMO, USA)
Algorithm	(from complex to simple) Higher accuracy – due to the use of original algorithms based on reference measurements	(from simple to complex) Lower accuracy due to the use of algorithms of search of several elements in the known volume.
Measurement accuracy	Operation with the set accuracy at different raw material moisture content values (especially relevant to the Russian market)	The measurement accuracy degrades significantly at the raw material moisture content above 23%
Quick configuration option	Quick software and structure modifications. The analyser re-adjustment to new mixes is up to 10% of its cost	Time-consuming and costly; it is required to engage the US qualified staff. The analyser re-adjustment to new mixes is 30-40% of its cost
Customer assistance in radiation source handling	Complex analyser support: source delivery/loading and assistance in the enterprise preparation to the work with the ionizing radiation source in compliance with the Russian laws	"Install and forget": No assistance in the source purchase/delivery/loading and enterprise preparation to the work with it in the Russian environment
Reliability of 24/7 operation	4 detector units (DU) adjusted to the Russian environment). In case of failure of the 1 DU, up to 10% of useful signal is lost. Remote troubleshooting is available.	2 detector units (not adjusted to the Russian environment), fall under the dual application restrictions. In case of failure of the 1 DU, up to 50% of useful signal is lost. Remote troubleshooting is unavailable.
Cost of finished product	Price: from 25 million rubles depending on a particular specification	Prince: from 40 million rubles. However, the radiation source should be purchased separately in the country of installation. The cost of radiation source with neutron output of $2*10^8 n/s$ in Russia starts from 2 million rubles.
Operating cost of finished product	Raw material analysers (both of Russian, and foreign manufacturers) do not require any operating costs, except for the system re-adjustment due to the change of the required raw material composition. In such a case, it is necessary to invite the qualified specialists of the developer to take measurements for the device calibration. Americans may charge several dozens thousand dollars. These figures are much lower in RATEK.	

The FREE PGNA analyser is used at the cement plant in Slantsy city (capacity of 500 tons of raw material per hour in a non-stop operation mode) since January 2016.

The analyser has processed **6,570,000 tons of raw materials** for the **1.5 years** of regular operation in Slantsy.

By now:

❑ The operational testing of FREE PGNA cement raw material analyser has been completed successfully;

❑ The experimental operation showed that FREE PGNA analyser fully meets the stated specifications;

❑ All necessary plant certification procedures have been completed successfully;

❑ Currently the equipment is integrated in the process flow and operates in a routine mode;

❑ The FREE PGNA equipment operates without additional control of preliminary installed similar equipment

We offer to fit your plants with the efficient, reliable and cost-effective equipment

–**FREE PGNA cement raw material analyser**

Efficient control (with the required probabilistic characteristics) of elemental composition of analysed materials

Cost-efficient system use comparative to alternative solutions

Embeddability in the existing production technology with the use of any ore raw materials: cement, oil, precious metals, all ore types

Quick and easy adjustability to solve various tasks

Loss reduction, manufacturing quality and efficiency improvement

Real-time operating reliability

THANKS FOR YOUR ATTENTION!

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RUSSIAN CEMENT MARKET

The Russian cement market is represented by more than 10 large a=manufacturers and about 20 small regional companies
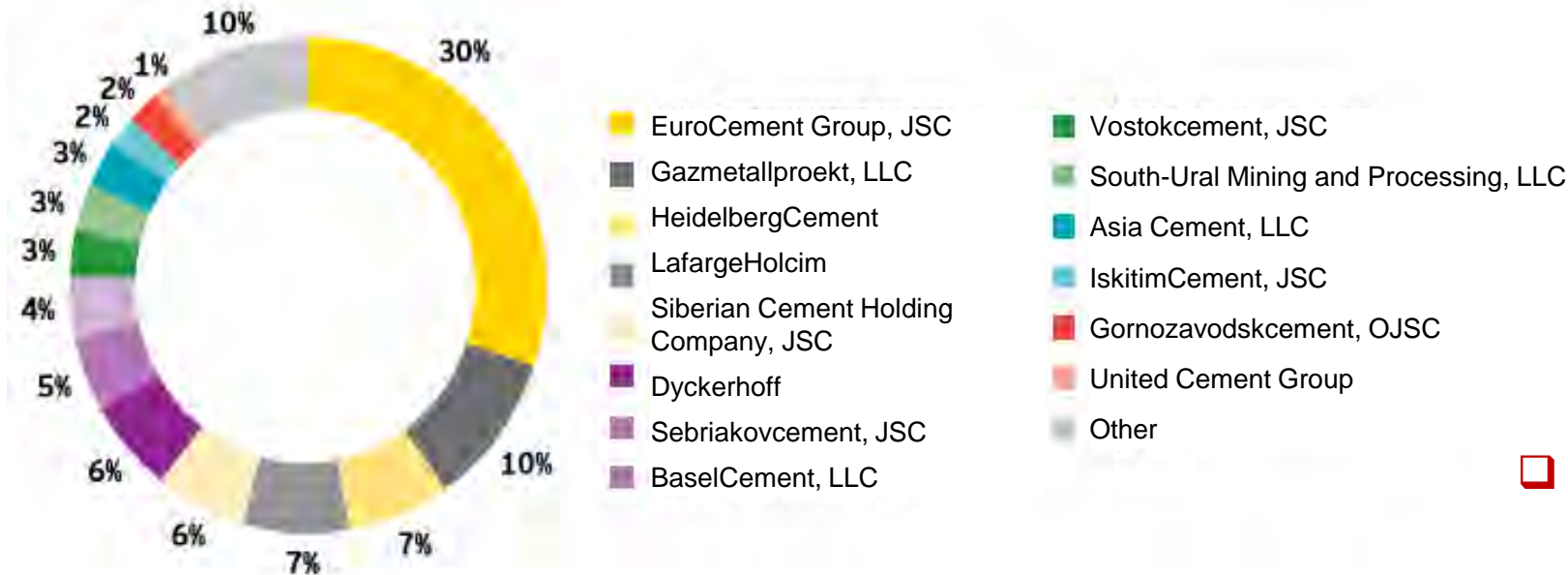
In 2016, the five largest production groups held 66% of the market

The total market share held by the largest manufacturers controlled by foreign cement holdings (LafargeHolcim, HeidelbergCement, Dyckerhoff и United Cement Group) was 22%

Russian cement market share of major players in 2016

- 30% EuroCement Group, JSC
- 10% Gazmetallproekt, LLC
- 7% HeidelbergCement
- 7% LafargeHolcim
- 6% Siberian Cement Holding Company, JSC
- 6% Dyckerhoff
- 5% Sebriakovcement, JSC
- 4% BaselCement, LLC
- 3% Vostokcement, JSC
- 3% South-Ural Mining and Processing, LLC
- 3% Asia Cement, LLC
- 2% IskitimCement, JSC
- 2% Gornozavodskcement, OJSC
- 1% United Cement Group
- 10% Other

❑ The overall cement production in Russia in 2016 was 55 million tons (by 11.4% lower than in 2015)

The cement consumption in 2016 was 55.9 million tons

The annual average growth in cement production volume in Russia in 2005-2016 was 3.9%

❑ The annual average growth in cement consumption in 2005-2016 was 5.1%

WORLD CEMENT MARKET

China is an undoubted leader in cement production (over 50% of the world market). The China is followed by India, USA, Brasilia, Iran, Vietnam, Russia and Turkey

In recent years, the demand for cement has grown; Asia-Pacific region is the leading consumer

Developed regions demonstrated the moderate growth, while the emerging markets are growing rapidly

TOP-5 players on the world cement market and their market shares:

1. China National Building Materials (CNBM), China – 20.2%
2. Lafarge Holcim, France – 16.8%
3. Anhui Conch, China – 13.4%
4. Jidong Development, China – 10%
5. Heidelberg Cement , Germany – 8.8%

Cement market structure breakdown by regions
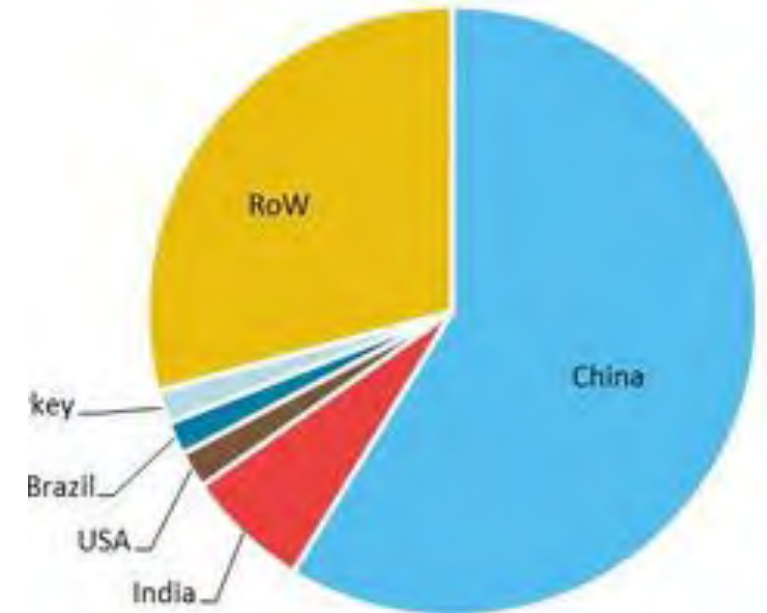
- ❑ World cement market volume in 2016 was 4.6 billion tons
- ❑ Annual average growth of the world market in 2009-2016 was 7%