INFOCM 2025

INTERNATIONAL FORUM ON CRITICAL MINERALS 2025

May 12(Mon) - 13(Tue), 2025
Conrad Seoul, Korea

PROGRAM BOOK

Chance! Challenge! Change!
Time to Share "Mid-Stream Technology"

Ministry of Trade, Industry and Energy

KIGAM

Ministry of Foreign Affairs

BỘ CÔNG THƯƠNG

VIỆN KHOA HỌC VÀ CÔNG NGHỆ MỎ - LUYỆN KIM
NATIONAL INSTITUTE OF MINING - METALLURGY SCIENCE AND TECHNOLOGY

VIMLUKI

OVERVIEW OF RESOURCES, CURRENT STATUS OF TITANIUM MINING AND PROCESSING IN VIETNAM

PhD: TA DƯƠNG SƠN
Deputy General Director of VIMLUKI

Seoul, 2025

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

In this presentation, I would like to share some main contents:

- Overview of VIMLUKI
- Potential of critical mineral resources in Vietnam
- Vietnam's policy on mineral development
- Titanium and Zircon Ore Resources in Vietnam
- Technology for exploiting and processing titanium ore in Vietnam
- Current status of research and application of titanium processing technology at VIMLUKI
- International Cooperation – The Key to Development
- Conclusion

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

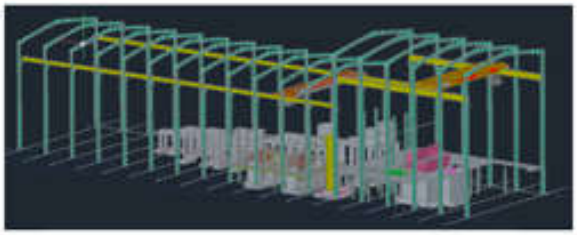
Overview of VIMLUKI

- Head Office
- Center for Research and Implementation Technology Application
- Southern Mining and Metallurgy Co., LTD
- Thai Nguyen Mining and Metallurgy Co., LTD

Human Resources: Total 230 people

- Postgraduate: 44 people
- Engineer Degree: 81 people
- Technician; Operator; Worker: 105 people

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn



Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

- Head Office
- Center for Research and Implementation Technology Application
- Southern Mining and Metallurgy Co., LTD
- Thai Nguyen Mining and Metallurgy Co., LTD

Human Resources: Total 230 people

- Postgraduate: 44 people
- Engineer Degree: 81 people
- Technician; Operator; Worker: 105 people

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

METALLURGY TECHNOLOGY DEPARTMENT

Nabertherm Rotary Tube Furnace (Germany), Annealing temperature 1100 °C, Φ100x2000 mm

Nabertherm Gas Regeneration Furnace (Germany), Φ100x1500 mm

Acid Resistant High Pressure Separator (India)

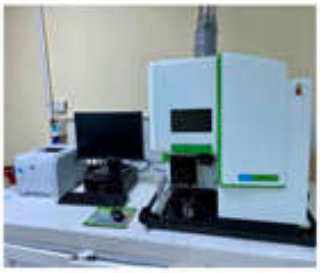
MINERALS PROCCESSING TECHNOLOGY DEPARTMENT

Laboratory of dry magnetic – electric processing

Pilot flotation line with capacity 150 kg/h

Column flotation machine

SOME TYPICAL EQUIPMENTS OF ANALYTICAL CENTER



Atomic absorption spectrometers and plasma emission spectrometers

Perkin Elmer Lambda 365 UV-VIS Spectrophotometer

Carbon-Sulfur meter (HORIBA-320V2)

Potential of critical mineral resources in Vietnam

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Vietnam is a country with diverse and rich mineral resources, stretching from the Northern mountainous region, the Central region to the Central Highlands and coastal areas. According to statistics, Vietnam has identified over 60 types of minerals with thousands of large and small mines and ore deposits. In particular, there are many important and essential minerals according to international classification such as:

- Rare earth: Vietnam is the second country in the world in terms of rare earth reserves. According to the 2022 announcement of the United States Geological Survey (USGS), the reserves and resources of rare earth in Vietnam are about 22 million tons, ranking second in the world, after China. The 5 countries with the largest rare earth reserves in the world include: China (44 million tons), Vietnam (22 million tons), Brazil (21 million tons), Russia (21 million tons), India (6.9 million tons). Rare earth in Vietnam is mainly concentrated in Lai Chau, Yen Bai, Lao Cai, Ha Tinh, Binh Dinh, Ninh Thuan, Binh Thuan ...
- Tungsten: Vietnam ranks 4th in the world in tungsten reserves, with 74 million tons of WO3 reserves. Nui Phao tungsten mine is one of the mines with the largest tungsten reserves in the world outside of China, with 52.5 million tons of WO3 ore with an average content of 0.21%; Accompanying ores include fluorspar, bismuth, copper, gold. In addition, tungsten is also distributed in some provinces such as Cao Bang, Ha Giang, Tuyen Quang, Nghe An ...

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

- Titanium – zircon – monazite: Vietnam's total resources and reserves of titanium ore (including both primary and placer ore) are estimated at about 650 million tons. Of which coastal placer titanium accounts for the majority (about 90%) — mainly in the provinces of Thua Thien Hue, Quang Tri, Quang Binh, Binh Dinh, Ninh Thuan, Binh Thuan.
- Nickel, Cobalt: According to the General Department of Geology and Minerals of Vietnam, Nickel resources and reserves are estimated at about 3.6 million tons. Mainly laterite ore containing Nickel, located in weathering layers in tropical regions. Cobalt is often associated with Nickel and Copper mines. Cobalt resources are estimated at about 0.5 million tons, mainly cobalt associated with nickel and copper, with no independent cobalt mines. It is an important raw material in green technology and batteries for electric cars. Nickel and cobalt in Vietnam are mainly distributed in the provinces of Son La, Thanh Hoa, Cao Bang, Quang Nam - Kon Tum.

These minerals are not only natural resources, but also strategic resources to promote the country's industrialization and modernization, associated with the goal of sustainable development and deep international integration.

Among the above minerals, titanium is a mineral that Vietnam has very large reserves with favorable mining conditions.

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Vietnam's policy on mineral development

The Vietnamese Government pays special attention to developing a sustainable, modern and internationally integrated mineral industry.

(Resolution No. 10-NQ/TW dated February 10th, 2022) Regarding the strategic orientation of geology, minerals and mining industry to 2030, vision to 2045.

- It presents a direction of strategies in a way of developing domestic private industrial enterprises as a driving force for developing national industries, and indicates a significance of maintaining a mineral mining industry.
- Aim to promote competitive industrial enterprises in the fields of geology, minerals and mining in the global market by 2030.
- Complete policies to encourage foreign cooperation and investment using advanced and modern technology in mineral processing.

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Vietnam's policy on mineral development

- (Decision No 334/QD-TTg dated February 01st, 2023) Announced a plan to last the geo-mineral strategy implemented by 2030 until 2045.

• To explore coal, uranium, titanium-zircon, rare earth element, phosphorite, copper, nickel, tin, bauxite, sand for glass and other minerals by 2045.

- (Decision No 886/QD-TTg dated July 18, 2023) Approving the planning for exploration, exploitation, processing and use of minerals for the period 2021-2030, with a vision to 2050.

•• Review, amend and supplement legal regulations related to the mining industry; amending the Mineral Law issued in 2010; Resolve problems in construction investment activities and reform some administrative procedures for businesses.

•• Promote scientific research, research and application of advanced technology to effectively process mineral resources; Investing in technological innovation, using advanced equipment in mining, selecting, and processing minerals to save resources, save energy, protect the environment,....

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Vietnam's policy on mineral development

Resolution No. 57-NQ/TW dated December 22, 2024 of the Ministry of Politics on breakthroughs in science, technology, innovation and national digital transformation

- Identify strategic minerals (including titanium) as important resources for developing high-tech industry, new materials, renewable energy, and national defense and security.
- Encourage deep processing and application of modern technology to increase added value and reduce import dependence.
- Prioritize international cooperation in research, application, and technology transfer for processing these minerals.
- Create a specific mechanism to attract businesses to invest in titanium processing, especially in joint venture and association models with foreign countries.

This is the guideline for Vietnam to continue expanding international cooperation to maximize the added value from minerals, especially titanium.

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Titanium and Zircon Ore Resources in Vietnam

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Mine type and origin

Titanium-containing minerals are very common and found in most types of rocks from sedimentary, metamorphic to magmatic. However, titanium ore deposits with industrial value in Vietnam have two main sources: Magmatic titanium ore; Eluvium-deluvium and coastal titanium placer ore (gray sand, red sand). Coastal titanium placer ore is the most valuable source type in Vietnam today. The ore has mineral compositions including ilmenite, leucoxene, rutile and a significant amount of zircon, monazite, xenotime. Coastal placers have been discovered, investigated, explored and exploited in Quang Ninh, Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien - Hue, Binh Dinh, Phu Yen, Ninh Thuan, Binh Thuan, Khanh Hoa, Ba Ria - Vung Tau.

Figure 1: Distribution map of titanium ore deposits in Vietnam

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Reserves and forecast resources

- Vietnam's forecasted reserves and resources of titanium ore are about 650 million tons of heavy minerals (of which about 78 million tons are zircon); the most concentrated is titanium placer ore in Binh Thuan province, about 599 million tons, accounting for 92% of the total reserves and resources of titanium ore - considered the "titanium capital" of Vietnam and also one of the largest region in the world.
- The main component is ilmenite ($FeTiO_3$ with an average TiO_2 content of about 45–55%.), in addition there is rutile, leucoxene, zircon and a part of monazite - a valuable rare earth source.
- The proportion of useful minerals in the ore ranges from 3% to 25%, requiring advanced deep processing and selection technology to optimize mining efficiency.
- Monazite in the ore after processing accounts for 0.2% to 1%, which is a valuable resource for recovering rare earth elements such as cerium, lanthanum, neodymium, etc., serving high-tech industries such as electronics, defense, renewable energy and electric vehicles.
- The recovery of rare earths from monazite is a strategic direction, but also requires advanced technology and strict radiation safety control - an area in which we are eager to cooperate with countries with technological strengths such as Korea, Japan, Germany...

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Technology for exploiting and processing titanium ore in Vietnam

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

- Vietnam has abundant titanium ore resources and is widely distributed in many territories. Titanium ore in Vietnam has two types: primary ore and placer ore.
- Original titanium ore in Thai Nguyen area: Mining according to the technological diagram: drilling and blasting → excavation → transportation → rough selection → fine selection (ilmenite and rutile ore).
- Coastal titanium ore (in gray and red sand layers): Mining according to the diagram: Hydraulic mining → rough selection → fine selection (ilmenite, rutile, zircon, monazite fine ore).

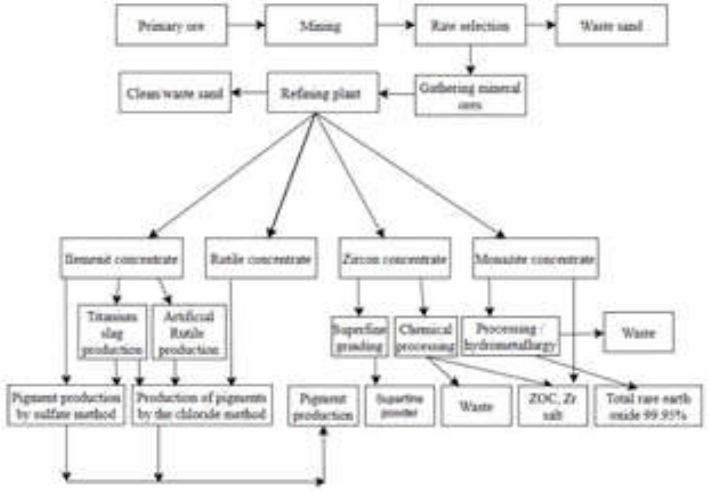


Figure 2: Production process of mining and deep processing of titanium ore

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Mining technology - raw material selection

Due to the characteristics of titanium ore bodies lying in the open or covered with a thin layer of sand, the mining technology in all mines is open-pit, without blasting. The main mining equipment is excavators, hydraulic guns, and sand pumps that directly suck from the ore body. The titanium mining and selection technology used by enterprises is mainly in the form of rolling, using suction pumps combined with a screw-based rough selection system placed on a mobile raft according to the mining site. The selection results in crude concentrates with a content of 55-90% heavy minerals (KVN).

Figure 3: Simulation of titanium placer mining technology

Figure 4: Schematic illustration of titanium mining technology, preliminary selection and sand discharge

1-Mining area; 2-Sand suction pump raft; 3-Suction pipe; 4-Location anchor; 5-Water gun; 6-Screws; 7-Float; 8-Ore mud discharge pipe; 9-Sand dump;10-Mechanical equipment for leveling ore to the mining moon (excavator, bulldozer)

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Refining technology:

- The technology for separating individual minerals in the heavy mineral group (refining) is usually: Raw ore with a content of 55 - 90% heavy mineral is put into magnetic and electrostatic separation equipment to separate ilmenite, rutile, zircon and other by-products (monazite and magnetite).

- The main technological processes in refining selection are often applied as follows:

+ Using magnetic separation to separate magnetite and ilmenite.

+ Use electric separation to separate the non-magnetic part, separate rutile, anatase (conducting part) and zircon, monazite (non-conducting part), then use strong magnetic separation to separate zircon and monazite.

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Titanium Ore Processing Technology in Vietnam:

- Titanium mining projects with a total capacity of 1.26 million tons/year. Titanium mining and processing facilities have made initial investments in deep processing. Nationwide, there are currently several factories producing reduced ilmenite with a capacity of 20,000 tons/year and 02 slag smelting factories that have produced phase 1 with a capacity of 84,000 tons/year (including 01 factory in Thai Nguyen, 01 factory in Binh Dinh) and about 11 production lines/factories for grinding fine zircon, superfine, and fine rutile powder. The artificial rutile and titanium pigment projects have not been implemented yet due to many reasons, but mainly because there are no technology transfer partners, especially due to the impact of the economic recession, some deep processing projects have not been implemented or had to be stopped.

- Some mines and titanium factories are operating at a low level of production because they have not yet mastered processing technology.

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Current status of research and application of titanium processing technology at VIMLUKI

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Regarding Titanium ore mining and selection: VIMLUKI is in charge of designing for many investors, typically mines in Binh Thuan: Hong Thang 1 (capacity 50,000 t/n); Hong Thang 2 (capacity 60,000 t/n); Luong Son 1 (capacity 160,000 t/n). Song Binh superfine zircon grinding plant (capacity 36,000 t/n), with a system of 06 grinding machines of various types (from Spain and Germany) along with a drying and cleaning line for raw materials. The project is built in Song Binh Industrial Park, Binh Thuan. Currently, the factory is operating stably and very effectively...

Figure 7: Song Binh Superfine Zircon Grinding Plant

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Regarding Titanium Slag Smelting: Most of the titanium slag factories in Vietnam are implemented by VIMLUKI: preparing projects, EIAs, coordinating with investors to purchase equipment and receiving transfers to units. Currently, the factories have mastered the technology, are proficient in operation, and have many effective slag production factories (although the equipment is old generation and low quality). The technology and equipment are entirely from China, but have produced products that meet international quality standards, meeting demanding markets such as Japan and Korea.

Figure 8: Hue titanium slag factory

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Regarding Titanium Ore Deep Processing: VIMLUKI has presided over the design and construction of the Song Binh TiO2 pigment processing plant - Binh Thuan province: The plant is designed based on Ukrainian production technology, however, due to the Russia - Ukraine war, the project has not yet been implemented.

Figure 9: Perspective of Song Binh Pigment factory

Some equipment VIMLUKI produces and supplies to manufacturing plants:

Fig6: Magnetic and electric separator produced by VIMLUKI

Figure 5: VIMLUKI production screw system

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

However, the deep processing of titanium ore is currently only at the experimental scale; the results are not reliable enough and the conditions for application in production or expansion on an industrial scale are not met. Therefore, the deep processing of titanium ore still faces many difficulties.

Some of the main difficulties in titanium processing technology:

- Haven't mastered core technology yet;
- Lack of technical infrastructure and capital to invest in high technology;
- Current technology is not efficient and stable enough for poor and complex ilmenite ore;
- In Vietnam's titanium placer ore contains a significant amount of rare earths, currently there is no suitable research to recover effectively;
- Equipment manufacturing capabilities are limited;
- The coordination between research and business is still ineffective.

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

International Cooperation – The Key to Development

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Vietnam wishes to strengthen cooperation with countries which have developed industries such as Korea, Japan, the United States, and the EU in various fields:

- Research and development of titanium processing technology (and associated useful minerals such as zircon, monazite) and rare earths;
- Transferring technology for processing products from titanium ore such as: titanium slag smelting, artificial rutile production, sponge titanium production, pigment and metal titanium production with modern technology, secure the environment;
- Building a critical mineral supply chain;
- Establishing a Center for technology cooperation and knowledge transfer between research institutes and businesses of the two countries.

We believe that the combination of resource potential and international technological capacity will create a breakthrough in the development of the titanium industry, rare earth in particular and important minerals in general in Vietnam.

We welcome public-private partnership initiatives, technology transfer and investment from international partners in the deep processing of titanium and other critical minerals.

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

On the Korean side:

On March 5, 2025, the Korean government sent a diplomatic note to the Vietnamese government, announcing the funding for the Project "Technology Cooperation Center for the Supply Chain of Critical Minerals in Vietnam":

+ Project implementation period from 2025 to 2029;

+ The sponsor is the Ministry of Trade, Industry and Energy (MOITIE). The project management agency is the Korea Institute of Advanced Technology (KIAT);

+ Total funding amount 16.60 billion KRW (about 11.58 million USD).

+ Korea Institute of Geoscience and Mineral Resources (KIGAM) and the National Institute of Mining - Metallurgy Science and Technology (VIMLUKI) have been assigned by the two countries to jointly establish this "Center for Technology Cooperation in the Critical Mineral Supply Chain".

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn

Conclusion:

In the context of the world strongly transforming towards greening and high technology, elements such as titanium and rare earths are playing a core role. With abundant resources, a commitment to sustainable development and a policy of deep international integration, Vietnam is ready to be a reliable partner in the global strategic mineral supply chain.

We respectfully invite countries, especially those with strengths in clean technology and new materials such as Korea, Japan, the United States and the EU, to cooperate with Vietnam to jointly exploit effectively, develop sustainably and create breakthroughs in the mineral industry.

VIMLUKI is a specialized unit in the field of scientific research, design consulting, and technology transfer in the field of mineral exploitation and processing; Always willing to cooperate with technology suppliers and investors around the world to transfer advanced technology to mining enterprises in Vietnam.

Add: 79 An Trach Str, Dong Da district, Ha Noi, Viet Nam Tel: (+8424) 3823-2986 Email: vimluki1967@vimluki.vn Web: http://www.vimluki.vn