INNOVATIVE TECHNOLOGIES AND PROSPECTS FOR COMPLEX PROCESSING OF LOCAL DOLOMITE RAW MATERIALS

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Abstract

This article analyzes modern technological solutions for the complex processing of dolomite raw materials from deposits in the Kashkadarya region (Dehkanabad) to produce high-value products, such as metallic magnesium, calcium carbonate, and other industrially significant compounds. The main objective of the study is to ensure efficient utilization of raw materials and the establishment of a zero-waste production cycle.

Keywords

Dolomite, complex processing, magnesium metal, calcination, silicothermic method, environmental efficiency, innovative technology.

Annotatsiya

Ushbu maqola yuqori qiymatli mahsulotlar – metall magniy, kalsiy karbonat va boshqa sanoat ahamiyatiga ega birikmalarni olish uchun Qashqadaryo viloyati (Dehqonobod) konlaridan olinadigan dolomit xomashyosini kompleks qayta ishlashning zamonaviy texnologik yechimlarini tahlil qiladi. Tadqiqotning asosiy maqsadi xomashyodan samarali foydalanishni ta'minlash va chiqindisiz ishlab chiqarish siklini yo'lga qo'yishdan iborat.

Kalit so'zlar: Dolomit, kompleks qayta ishlash, metall magniy, kalsinatsiya (kuydirish), silikotermik usul, ekologik samaradorlik, innovatsion texnologiya.

Introduction

Dolomite [CaMg(CO3)2] is a versatile mineral widely used in metallurgy, construction, and the chemical industry. Despite the vast reserves of dolomite in Uzbekistan, particularly in the Kashkadarya region, the level of deep processing remains insufficient. Currently, moving beyond primary crushing to implement technology for extracting pure magnesium metal would significantly increase economic efficiency.

Main Body

It is proposed to implement the complex processing of dolomite through a two-stage technological scheme:

Thermal Activation (Calcination): By decomposing dolomite at temperatures of 750–900 C, active calcined dolomite (MgO CaO) is obtained. Capturing the CO2 released during this stage and reusing it in subsequent industrial processes is environmentally and economically sound.

1-step

$CaMg(CO_3)_2 \rightarrow CaCO_3 + MgO + CO_2$

The $MgCO_3$ component decomposes first, forming half-calcined dolomite.

The temperature is 550–700 (usually 650–750) .

2- step

$CaCO_3 \rightarrow CaO + CO_2$

$CaCO_3$ decomposes to yield fully active CaO·MgO.

The temperature is 810–930 (usually 850–900).

Complete calcination:

$CaMg(CO_3)_2 \rightarrow CaO+MgO+2CO_2$

Parameter	**Stage 1 (Mg part)**	**Stage 2 (Ca part)**	**Overall Process**
Reaction	$CaMg(CO_3)_2 \rightarrow CaCO_3 + MgO + CO_2$	$CaCO_3 \rightarrow CaO + CO_2$	$CaMg(CO_3)_2 \rightarrow CaO + MgO + 2CO_2$

Temperature (°C)	550–750	810–930	750–950
Released CO_2 (mol)	1	1	2
Product	Partially Calcined Dolomite	Fully Calcined Dolomite	Active CaO·MgO
Purpose	Activation of MgO	Achieving full activity	Industrial raw material

Chemical-Metallurgical Processing:

Silicothermic Method: Producing high-purity magnesium metal via vacuum thermal reduction of magnesium oxide using silicon (or ferrosilicon).

Hydrometallurgical Method: Separating magnesium and calcium salts through acid dissolution of dolomite. This method enables the production of high-purity precipitated calcium carbonate (PCC), which is a vital raw material for the pharmaceutical and paper industries.

Acid Leaching of Dolomite:

With Hydrochloric Acid (HCl) – most common method:

$CaMg(CO_3)_2 + 4HCl \rightarrow CaCl_2 + MgCl_2 + 2CO_2 + 2H_2O$

With Nitric Acid (HNO_3):

$CaMg(CO_3)_2 + 4HNO_3 \rightarrow Ca(NO_3)_2 + Mg(NO_3)_2 + 2CO_2 + 2H_2O$

With Sulfuric Acid (H_2SO_4) – for obtaining $MgSO_4$:

$CaMg(CO_3)_2 + 4H_2\ SO4 \rightarrow Ca\ SO4 + Mg\ SO4 + 2CO_2 + 2H_2O$

Separation of Calcium and Magnesium and PCC Production:

Precipitation of PCC (Precipitated Calcium Carbonate):

$CaCl_2 + Na_2CO_3 \rightarrow Ca\ CO_3 + 2NaCl$

or using CO_2 gas:

$CaCl_2 + 2NaOH + CO_2 \rightarrow Ca\ CO_3 + 2NaCl + H_2O$

Stage	Process Name	Main Reaction / Action	Temperature (°C)	Purpose / Product
1	Dolomite Grinding	Grinding to particle size 50–200 µm	Room temp.	Increase leaching efficiency
2	Acid Leaching	$CaMg(CO_3)_2 + 4HCl \rightarrow CaCl_2 + MgCl_2 + 2CO_2 + 2H_2O$	50–90	Dissolution of Ca^{2+} and Mg^{2+}
3	Filtration and Purification	Neutralization of excess acid, separation of residue	40–60	Obtaining clean solution
4	Calcium Separation (PCC)	$CaCl_2 + Na_2CO_3 \rightarrow CaCO_3\downarrow$ (PCC)	20–80	High purity PCC (98–99.9%)
5	Magnesium Separation	$MgCl_2 + 2NaOH \rightarrow Mg(OH)_2\downarrow$	30–70	$Mg(OH)_2$ or subsequent MgO
6	Drying and Calcination	$Mg(OH)_2 \rightarrow MgO + H_2O$	300–900	Magnesium oxide or other magnesium salts

The research results indicate that the low content of iron and silicon oxides in Dehkanabad dolomite makes it an ideal raw material for the production of metallurgical-grade magnesium.

Conclusion

Implementing complex processing technology for dolomite not only facilitates the production of import-substituting goods (such as magnesium alloys) but also minimizes waste, aligning perfectly with the principles of "Green Technologies." Future research

should focus on optimizing the energy consumption of the process and enhancing the efficiency of catalysts.

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