

An aerial photograph of a mining operation. In the lower-left, a yellow excavator with a black and yellow striped boom is positioned. In the lower-right, a large, dark-colored dump truck is parked. The background is a vast, deep, reddish-brown mining pit with visible rock formations and tracks.

# Mining and Metal Purification

PatSnap Analytical Report



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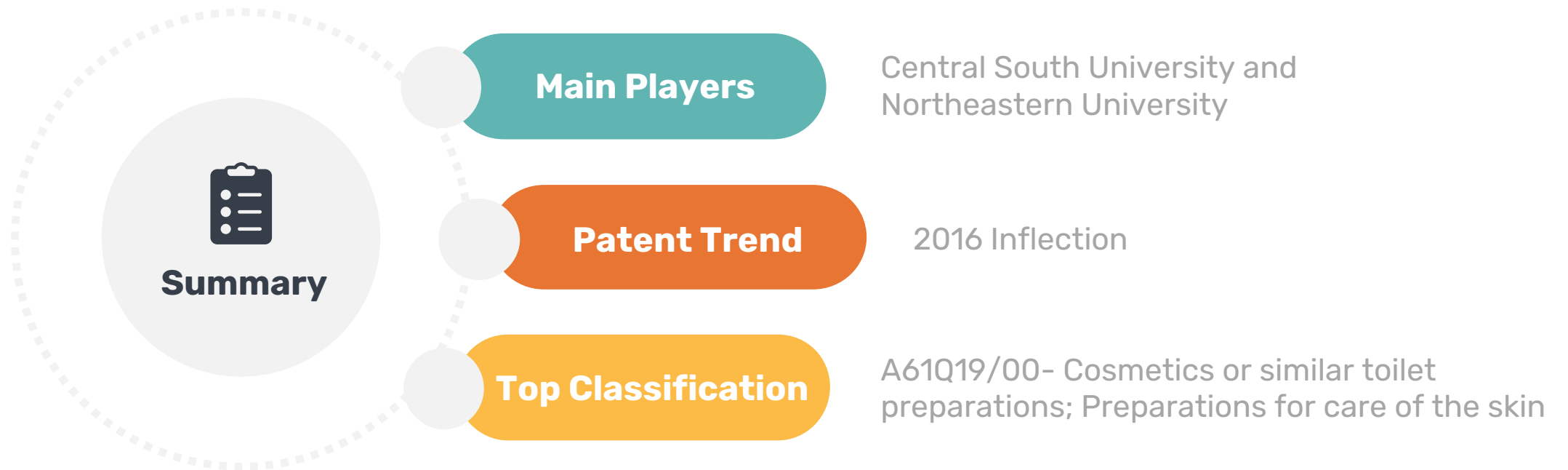
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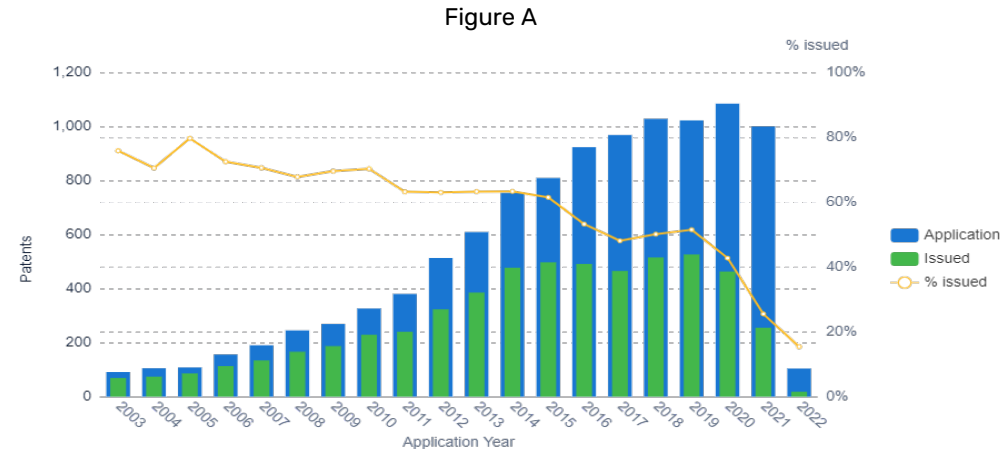
## Top Companies

Companies with the most patent activity

# Executive Summary



# Application Trends



**Figure A** shows the application trends for the Metal Mine Purification industry from 2003 to 2022. As the chart illustrates, growth remained steady from 2003 to 2011. Then in 2012 to 2016, it was exponential. This appears to be an inflexion point in terms of the level of innovation that took place that year. **Overall, growth in innovation within this area strongly indicates that companies see value, and consistently invest in their R&D Departments to improve technologies used within the "Metal Mine Purification" sector. Specified below are three companies that are focusing on key innovative technologies**

**In 2012, SHAANXI UNIV OF SCI & TECH** was the **leading assignee** with **15** patent publications followed by **KUNMING UNIV OF SCI & TECH** with **11** publications. A staggering **14 out of 15** patents of SHAANXI UNIV's patents in 2012 were related to **C04B35** technology space.

**In 2016, JIANGSU PROVINCE METALLURGICAL DESIGN INST. led** with **52 patent publications**, followed by **CENT SOUTH UNIV** with **21 publications**. Jiangsu's patents were related to the **C22B1** technology space while **Cent's** portfolio is **focused on C22B7 & C22B15**. Jiangsu's patent, [CN106148715A](#), which is a "method and system for treatment of kiln slag" had seven citations, representing the most cited patent at that time.

**In 2020, 48.43%** of the applications were still **pending**. **B03D1** and **B03B9** were the technology areas **having the bulk of the patents**. **CENT SOUTH UNIV** and **KUNMING UNIV** were the top assignees with **30 & 26** patent publications, respectively. Cent's patent [CN112573552B](#) - Method for preparing Bumsite with high silicon- aluminum material was among the most claim heavy patents with **22** claims.

# Top Patent Classification Codes

## *Separating solid materials using combinations of wet processes*

**Top Jurisdiction: CN**

- **Top Assignee: Northern Engineering (NETC)**
- **Key patent (highest valued/most cited):** [CN108580029A](#)

**B03B7/00**

## *General arrangement of separating plant*

- **Top Jurisdiction: CN**
- **Top Assignee: Northern Engineering (NETC)**
- **Key patent (highest valued/most cited):** [CA2697521A1](#)

**B03B9/00**

## *Flotations*

- **Top Jurisdiction: CN**
- **Top Assignee: Cent South Univ & Kunming Univ (22 each)**
- **Key patent (highest valued/most cited):** [TWI642792B](#)

**B03D1/00**

## *Separating solid materials using collectors*

- **Top Jurisdiction: CN**
- **Top Assignee: Cent South Univ**
- **Key patent (highest valued/most cited):** [US20150090666A1](#)

**B03D101/02**

**Figure B** displays the top technologies that the mining industry is developing new innovations in. The top assignees and jurisdiction is also provided.

# Technology Classifications

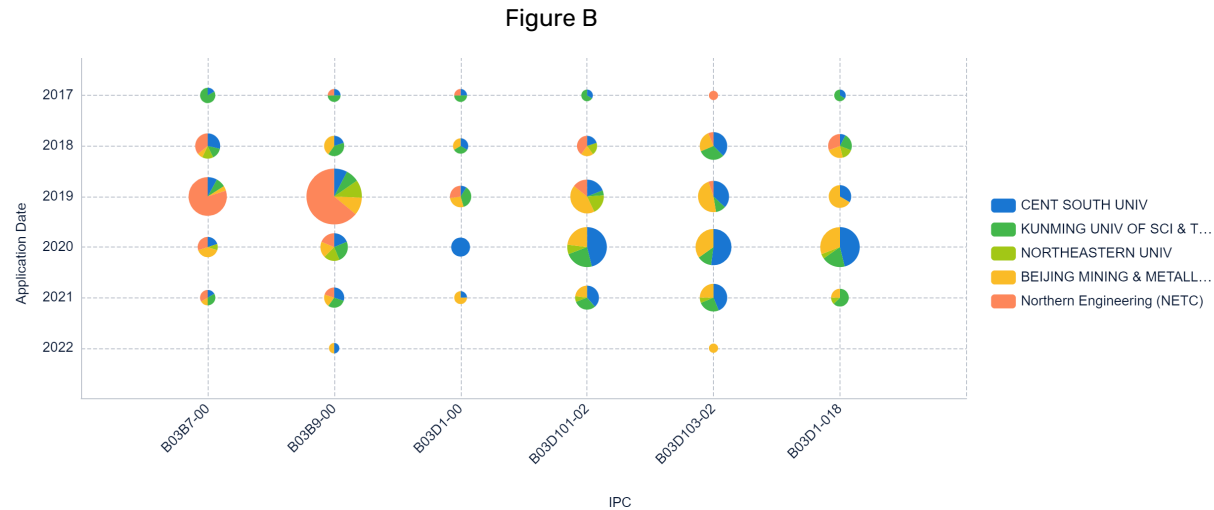


Figure C depicts the application trend of the major technology areas in the field of metal mine purification. Figure B showcases that the highest number of patent applications in the field of over the past five years have been filed in under the IPC of **B03B9/00** which describes inventions pertaining to the general arrangement of separating solid material plant, such as flow sheets.

Further analysis of these codes reveals that there are **203** patent publications that discuss the **magnetic separation** method for refining metal mines. One noteworthy patent to look at is [CN106868292B](#) by **NORTHEASTERN UNIV** which talks about the apparatus and method of multi-stage iron ore suspension using magnetic separation and has been valued at **\$310,000**. Since 2017, **NORTHERN ENGINEERING (NETC)** has the most published patents (20 active and 3 pending) under IPC B03B9/00 followed by **KUNMING UNIV** which has published 16 patents (10 active and 4 pending).

Clearly, **CENT SOUTH UNIV** has the most patent publications (41 active & 6 pending) in top 5 technology areas, and we also see **BEIJING MINING & METALLURGICAL TECH** is a top new entrant in this industry with 62 applications in last 5 years. There is no monopolization of patent filings, suggesting that there are new players in the industry producing innovative ideas. For example, the top companies with the largest patent portfolios in the technology field **post 2017 filings had less than 20% of the total patent application filings**.

# Top Companies



- Patent Portfolio Size: 261
- Simple Families
- Percentage of Active Patents: 64%
- Top IPC code: B03D103/02
- Top filing jurisdiction: CN



- Patent Portfolio Size: 209
- Simple Families
- Percentage of Active Patents: 32%
- Top IPC code: B03D101/02
- Top filing jurisdiction: CN



- Northeastern Univ
- Patent Portfolio Size: 178
- Simple Families
- Percentage of Active Patents: 48%
- Top IPC code: C22B1/02
- Top filing jurisdiction: CN



- Patent Portfolio Size: 128
- Simple families
- Percentage of Active Patents: 47%
- Top IPC code: C04B28/14
- Top filing jurisdiction: CN



- Patent Portfolio Size: 120
- simple families
- Percentage of Active Patents: 35%
- Top IPC code: B03B7/00
- Top filing jurisdiction: CN

# Top Companies

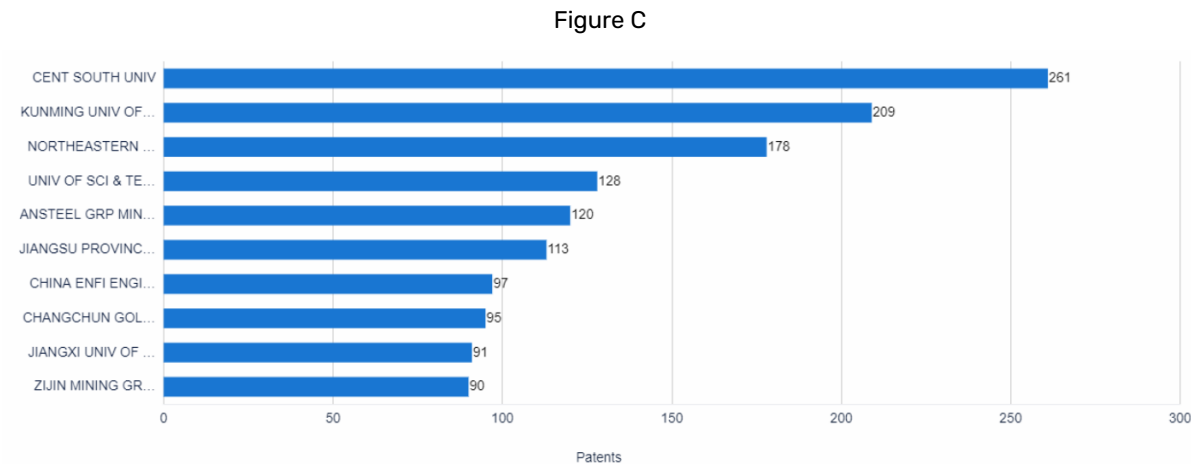


Figure D illustrates the top ten companies with the most patents within the 'metal mining purification' industry; all of which are from China. The most notable key players are Cent South Univ, Kunming Univ, and Northeastern Univ (China) where **Cent South Univ** leads the list with **261 patents**. Since 2016, Cent South Univ has been filing over 20 patents each year, peaking in 2021 with 32 patents. Out of its 261 patents, **198** are 'active/pending', with **59** classed as 'inactive'. Cent South Univ also has the largest patent portfolio within this group at **\$11M USD**

**Jiangsu Province Metallurgical Inst** is quite interesting look at as this assignee filed for the over 90% of their total patent applications in the year 2016 & 2017 (106 out of 113). The top inventor for these applications was **Wu Daohong** with 107 patent applications. Out of its 113 patents, **68** are 'active/pending', with **45** classed as 'inactive'

The other prominent patent applicant is **NORTHEASTERN UNIV** whose patent [CN101734698A](#) - Method for preparing aluminum oxide from aluminiferous material has the most citations at 90. The estimated expiry of the patent is **September 2029**.

China Enfi Engineering Corp. is another significant company in the industry. Their innovations mostly relate to **C22B23 IPC classification code which comprise of inventions relating to production or refining of metals mostly Nickel or Cobalt**. An interesting patent from their portfolio is [CN111926133A](#) titled Smelting method and smelting device for iron-based ores as it is the most claim heavy patent among the top assignees with 32 claims.



# End Notes

## The query used to gather relevant results:

TAC\_ALL:((mining OR mine) \$para (metal OR copper OR nickel OR Iron OR gold OR silver OR tungsten OR lead)) AND  
TAC\_ALL:(tailings OR waste OR purification OR purify OR sludge)

### NOTE:

- The results for the patent graphs are based on simple families, specifically active and pending patent filings worldwide.
- All assignee mentioned in the report are standard current assignees unless stated otherwise
- Application filing data from the years 2021 and 2022 is subject to change as there are delays in publication of patent application in the public domain

The patents are in your workspace under “Report”, with corresponding patents to each figure. Each folder also has subfolders of important analysis, for example Chinese only patents.

# Connecting the dots so you can innovate better

Founded in 2007, PatSnap is the company behind the world's leading Connected Innovation Intelligence platform. PatSnap is used by more than 10,000 customers in over 50 countries around the world to access market, technology, and competitive intelligence as well as patent insights needed to take products from ideation to commercialization. Customers are innovators across multiple industry sectors, including Biotechnology, Medical devices, Pharmaceuticals, Chemical, Electronics Manufacturing, Automotive, Consumer Goods, Aviation & Aerospace, Education, and Legal Firms.

PatSnap's team of 1000+ employees work from its global headquarters in Singapore, London, and Toronto. To learn more about how PatSnap is improving the way companies innovate, visit [www.patsnap.com](http://www.patsnap.com).