Metallugical and Mining Engineering

Starting salary (for Mining Engineering): $64,404
Median Income: $84,320

Metallurgical engineers turn raw materials into useful products. Metallurgical engineering includes processing mineral and chemical resources into metallic, ceramic or polymeric materials; creating new high strength or high performance materials; or developing new ways to refine and process materials for new consumer applications.

A strong background in the fundamentals in chemistry, mathematics and physics as well as an affinity for thermodynamics, fluids, transport phenomena, strength of materials and material properties is required.

The Department of Metallurgical and Materials Engineering at Montana Tech of the University of Montana describes the five areas of specialization in metallurgical engineering as follows:

- Mineral Processing Engineering: Mineral processing engineers take advantage of differences in physical and/ or chemical properties to develop, manage, and control processes for liberating, separating and concentrating valuable minerals in associated waste rock.
- Extractive Metallurgy: Extractive metallurgical engineers produce and purify metals from ores, concentrates and scrap using hydrometallurgical (water chemistry), electrometallurgical (electrochemistry), and/or pyrometallurgical (thermal chemistry) technologies.
- Physical Metallurgy: Physical metallurgical engineers process the metals into products by alloying, forging, rolling, casting, powdering, etc. in order to control their various chemical, physical and mechanical properties such as corrosion resistance, strength, ductility, etc.
- Materials Engineering: Materials engineers apply similar principles as the above engineers to develop the best materials for an application form, for example, ceramics, glasses and

Job Outlook

Employment of mining and geological engineers is projected to grow 12 percent from 2012 to 2022, about as fast as the average for all occupations. Still, the expected growth of the occupation will not be large, in terms of the number of new positions overall, because the occupation is a relatively small one.

Industries with the highest levels of employment in this occupation:

1. Architectural, Engineering, and Related Services
2. Metal Ore Mining
3. Coal Mining
4. Management of Companies and Enterprises
5. Support Activities for Mining

Top paying industries for this occupation:

1. Management of companies and enterprises
2. Support activities for mining
3. Metal ore mining
4. Coal mining
5. Architectural, engineering, and related services

Source: US Bureau of Labor Statistics

polymers as well as certain minerals and metals.

- Welding Metallurgy: Welding engineers are concerned with joining materials together, particularly metals, to produce efficient joints with minimum damage to the integrity of the materials being joined.

The Footsteps of a Metallurgical Engineer

Way back in the Dark Ages, when I was about 11 years old, my family used to have dinner parties – the kind with candles and good china. Being the youngest child, I was given the honor (and I really did think it was an honor) of putting out the candles after dinner. I hate that carbon black that builds up on the inside of snuffers when you put out lots of candles, so, one night when I was using Mom's pewter candle snuffer, I kept the snuffer in the flame to melt off the black stuff. Well, what do you know! The pewter snuffer melted. I then grabbed Mom's brass snuffer and tried the same experiment. I couldn't melt the brass. Why not? And there started my interest in materials. (By the way, I didn't get grounded for this science experiment, but Mom didn't leave her pewter things out anymore.)

Our neighbor at that time was the trauma surgeon for U.S. Steel in Gary, Indiana. He was able to arrange a tour of the facility for us. Do you have any idea how exciting steel mills are? The engineers sure got to do some neat stuff. It's amazing how you can take raw materials, melt them together into a liquid, and then turn it into steel plate or sheets. I still remember how amazed I was at how big those pots of molten metal were and how wild it was to see a big slab of metal get shaped into long, thin plates.

One summer my folks took us on a trip to Ontario, Canada, where we visited the Big Nickel Mine. I was fascinated by the tour guide's stories. He said the mills used to pour the slag from the molten metal down the hills and vegetation was destroyed. Then NASA used the ruined landscape to practice lunar walking. I really liked going down into the mine and learning how the ore is extracted and turned into objects we use every day.

Since we lived near Chicago we toured the Museum of Natural History and its reproduction of an actual coal mine. All these tours made me want to explore the field of materials. But, to be truthful, I didn't enter college determined to be a metallurgist. Originally, I wanted to be a chemist, but my high school chemistry teacher told me to major in engineering, instead of chemistry, so I would have a better chance of getting a good job. At Notre Dame all students take "Freshmen Studies." You don't declare a major your first year. If you think you want to be an engineer, you take physics instead of history as an elective. During freshman year I visited the metallurgical engineering department. They were very friendly and told me about the courses they offered. That's when I officially went into metallurgy.

Today, I am a systems engineer. This means that I look at the big picture for my projects. In theory, systems outranks all the other engineering disciplines. We coordinate everything to make sure that the mechanical folks don't do something to cause software too much heartburn and that operations can actually produce the gizmo. A good systems engineer has a broad knowledge of all engineering fields without necessarily being an expert in any one particular area.

Maribeth McCarthy retired from BAE SYSTEMS and now leads the Continental Math and Math Olympiad teams for Bicentennial Elementary School. She frequently demonstrates interesting material concepts for school groups.

If you are interested in a career in materials science and engineering or just want to learn more about it, visit the Materials Information Society at asminternational.org.

Glossary of Terms

Alloy – a metal made by melting and mixing two or more metals or a metal and another material together (merriam-webster.com)

Analyze - to study (something) closely and carefully : to learn the nature and relationship of the parts of (something) by a close and careful examination (merriam-webster.com)

Concentrate – to make (something, such as a liquid) stronger by removing water (merriam-webster.com)

Corrosion – the action, process, or effect of corroding (merriam-webster.com)

Design – to plan and make (something) for a specific use or purpose (merriam-webster.com)

Extract – to separate (a metal) from an ore (merriam-webster.com)

Forge – to form (metal) by a mechanical or hydraulic press with or without heat (merriam-webster.com)

Manufacture - the process of making products especially with machines in factories (merriam-webster.com)

Ore – a naturally occurring mineral containing a valuable constituent (as metal) for which it is mined and worked (merriam-webster.com)

Polymer – a chemical compound that is made of small molecules that are arranged in a simple repeating structure to form a larger molecule (merriam-webster.com)

Process – a series of actions that produce something or that lead to a particular result (merriam-webster.com)

Purify – to free from undesirable elements (merriam-webster.com)

Refine – to free (as metal, sugar, or oil) from impurities or unwanted material (merriam-webster.com)

Thermodynamics - a science that deals with the action of heat and related forms of energy (merriam-webster.com)

ABET Accredited Programs in Metallurgical and Mining Engineering			
School Name	**Location**	**Website**	**Program and Degree Name**
Colorado School of Mines	Golden, CO, US	www.mines.edu	Metallurgical and Materials Engineering, BS
Colorado School of Mines	Golden, CO, US	www.mines.edu	Mining Engineering, BS
Missouri University of Science and Technology	Rolla, MO, US	www.mst.edu	Metallurgical Engineering, BS
Missouri University of Science and Technology	Rolla, MO, US	www.mst.edu	Mining Engineering, BS
Montana Tech of the University of Montana	Butte, MT, US	www.mtech.edu	Metallurgical and Material Engineering, BS
Montana Tech of the University of Montana	Butte, MT, US	www.mtech.edu	Mining Engineering, BS
Pennsylvania State University	University Park, PA, US	www.psu.edu	Mining Engineering, BS
South Dakota School of Mines and Technology	Rapid City, SD, US	www.sdsmt.edu	Metallurgical Engineering, BS
South Dakota School of Mines and Technology	Rapid City, SD, US	www.sdsmt.edu	Mining Engineering, BS
Southern Illinois University at Carbondale	Carbondale, IL, US	www.siu.edu	Mining Engineering, BS
The University of Alabama	Tuscaloosa, AL, US	www.ua.edu	Metallurgical Engineering, BSMtE
University of Alaska Fairbanks	Fairbanks, AK, US	www.uaf-cem@alaska.edu	Mining Engineering, BS
University of Arizona	Tucson, AZ, US	www.arizona.edu	Mining Engineering, BS
University of Kentucky	Lexington, KY, US	www.uky.edu	Mining Engineering, BSMIE
University of Nevada, Reno	Reno, NV, US	www.unr.edu	Mining Engineering, BS
University of Texas at El Paso	El Paso, TX, US	www.utep.edu	Metallurgical and Materials Engineering, BSMME
University of Utah	Salt Lake City, UT, US	www.utah.edu	Metallurgical Engineering, BS
University of Utah	Salt Lake City, UT, US	www.utah.edu	Mining Engineering, BS
Virginia Polytechnic Institute and State University	Blacksburg, VA, US	www.vt.edu	Mining Engineering, BS
West Virginia University	Morgantown, WV, US	www.wvu.edu	Mining Engineering, BS