

# Vale's Base Metals Video Series

## Video 8: Processing

Video	Audio/Narration
Announcer intro over graphic title:	Vale's Base Metals Business Series — Focusing on processing and refining
See ancient alchemists, engravings, etc.	People have been trying to solve the riddle of metal refining since ancient times, constantly asking "how can we take minerals and refine them into valuable metals?"
Dissolve through to modern refining montage Best shots of processes [montage]	Today processing ore into metal is one of most complex industrial processes on earth.
Mill, operations and processes	How we extract metal varies according to the type of ore and the level of purity we will need in the final product.
BRANCH SCHEMATIC: SUPER TITLE OVER SCHEMATIC: CONCENTRATING  See ore before and after concentrating  See ore to indicate "metals" in ore  See in-mine processing  Show montage of grinding, chemicals being added, water and furnace	All ores need concentrating. Even the richest ore will only have a small percentage of the mineral we need. The valuable mineral has to be separated from the surrounding rock or uneconomic material.  We want to remove all this unwanted material and increase the concentration of metal at every stage.  Concentrating begins right in the mine with efficient mining methods. We then use a combination of mechanical, chemical and physical concentrating processes combined with water and/or heat.
See lateritic ore, then kilns  See nickel matte	Lateritic ores contain chemically-bound water that must first be removed through a drying process in high-temperature kilns.
See sulphide ore, then crushing or grinding mill process	Nickel and Copper sulphide ores need further crushing and grinding to liberate the valuable minerals from rock.
See various milling stages, then see slurry.	The mixture, or slurry, is fed into a rotating mill, where heavy steel rods or balls grind the rock. The ore is crushed into a fine powder and mixed with water. This process makes handling the ore easier and helps free valuable minerals, while improving surface contact for the next stage of processing.

## Video 8: Processing (cont'd)

Video	Audio/Narration
<p>See feed slurry, then multiple screen/montage of various stages: flotation, blast furnace, smelters, cathode,</p>	<p>The feedstock produced requires further concentration of the valuable minerals.</p> <p>Depending on the type of ore and the final product required, we can choose different types of processing.</p>
<p>BRANCH SCHEMATIC: show flow-sheet in simplified path: flow to SUPER TITLE OVER SCHEMATIC: Flotation/separation</p> <p>See processes in various locations and intensities</p> <p>See froth in detail</p> <p>See froth, bubbles and skimming</p> <p>See water and chemical additives</p>	<p>The main mineral processing method for copper-nickel sulphide is flotation separation.</p> <p>Different minerals respond to water and to various added chemicals in diverse ways.</p> <p>By knowing the minerals' respective surface properties, we can separate the different minerals in the feedstock.</p> <p>The valuable minerals such as nickel and copper adhere to the air-bubbles which form the froth floating on the surface and can be skimmed off.</p> <p>The flotation process can include a number of different stages, each stage allowing ever-more intense concentration of the different base metals. At the same time, trace impurities can be rejected.</p>
<p>See dryer processing</p> <p>See powder concentrate</p>	<p>The concentrate that results is filtered and dried. The concentrated powder must be further refined to remove iron, sulfur and other impurities.</p>
<p>BRANCH SCHEMATIC: show flow-sheet in simplified path: Refining</p> <p>Smelter or Hydromet path See water vs fire processing b-roll side-by-side, imagery</p> <p>SUPER TITLE OVER SCHEMATIC: HYDROMETALLURGICAL REFINING</p> <p>See hydromet plant flow-sheet schematic</p> <p>See Goro operations</p> <p>See Long Harbour processes</p> <p>Overview of the plants</p>	<p>The choice of method for the next stage is either water-based or fire-based.</p> <p>The water-based process method is called hydrometallurgical refining, or "hydromet" for short.</p> <p>Hydromet processing uses water-based chemical treatment to extract nickel from the concentrate and refine it to finished nickel.</p> <p>This leading edge technology is at the heart of Vale's new facilities at Goro, New Caledonia and Long Harbour Canada. Hydromet is also used at Tres Valles in Chile with biological agents and acid.</p> <p>Hydromet technology totally eliminates smelting and the air emissions it produces.</p>

## Video 8: Processing (cont'd)

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<p>Pyrometallurgical examples</p> <p>BRANCH SCHEMATIC super: SMELTING</p> <p>See smelting in furnace</p> <p>See schematic of modern oxygen furnaces</p>	<p>This differs from the ancient and traditional method of metal refining that uses fire. The fire-based process, or smelting, is called Pyrometallurgy.</p> <p>This process, used by Vale in Canada, Indonesia and Brazil, uses thermal treatments to extract metals and takes place in powerful Flash or Electric furnaces.</p> <p>Modern smelting furnaces have changed dramatically. They have been re-designed and calibrated to reduce emissions and remove impurities.</p> <p>The result of smelting and converting is a liquid metal matte and a fluid slag containing iron silicates.</p>
<p>See matte</p> <p>Slag re-furnacing</p> <p>Slag pour, Sudbury</p>	<p>Slags are re-processed in an electric furnace to recover any residual nickel and copper. The remaining slag is safely sequestered in berms prior to re-vegetation.</p>
<p>BRANCH SCHEMATIC: FLUID-BED ROASTING</p>	<p>The liquid metal matte is then further refined with a variety of processes.</p>
<p>See Sudbury FBR, process shots, then see nickel oxide products</p> <p>Off-gas scrubbing technology</p>	<p>Fluid-bed roasting suspends the fine particles in a stream of hot gases to produce high-grade nickel oxides.</p> <p>Vale in Sudbury, Canada has invested heavily in new fluid-bed roaster scrubbing technology to capture sulphur dioxide gas and convert it to sulphuric acid and liquid sulphur dioxide for re-sale.</p>
<p>BRANCH SCHEMATIC: Carbonyl processing</p> <p>See Wales, See pellets</p>	<p>Another method, the carbonyl process, uses the chemical reaction between carbon monoxide and nickel to produce high-purity nickel pellets and powders.</p>
<p>BRANCH SCHEMATIC: ELECTROWINNING</p> <p>See process</p>	<p>Electrowinning, which refers to the passage of an electrical current through the solution, is used to plate high purity copper from the residue of the nickel carbonyl process.</p>
<p>See more detailed copper refining and products</p>	<p>Copper sulphide concentrate containing 33% copper can be produced in the mill by flotation, or it can further refined to nearly 99% purity.</p>
<p>See PGM products</p> <p>See end-uses</p>	<p>The platinum group metals, cobalt, gold and silver are also recovered at different stages throughout the refining process, as these trace minerals are found in the same ore.</p>

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See cobalt production process	Cobalt is electrowon to produce “rounds”, which are 1” diameter cobalt discs, deposited onto stainless steel sheets. Cobalt is used in the production of super alloys, tool steels, magnetic alloys and in many other chemical applications.
<p>Montage of refining processes, time-dissolve process</p> <p>See new technology and the environment</p> <p>See various re-greening footage</p> <p>End on faces, emphasize diversity</p>	<p>Producing useful metal from a massive piece of rock isn't magic... but sometimes it can seem to be.</p> <p>Due to the complex nature of both the earth's ore and rapidly changing technology, the refining of metals presents an extraordinary human challenge.</p> <p>To continue to thrive, the mining industry must find the perfect balance between safe operation, quality, productivity, risk management, and the environment.</p> <p>At Vale's base metals business, doing things better is our daily objective.</p>
Title rundown	To learn more about how we are transforming mining please watch the other videos in this series.
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