



Rudy Tenbergen is a Senior Process Specialist with Paterson & Cooke's Canadian practice based in Sudbury, Ontario. He is co-named on several patents covering tank dewatering of mineral slurries to paste consistencies, treatment of acidic smelter gas cleaning bleed streams, and the application of flotation aids for nickel recovery.

In his 40 year career, Rudy has been instrumental in the development of paste and thickened tailings dewatering processes for both surface disposal and underground backfill. His early work in the 1990's pioneered the technology through the design and execution of pilot tests for paste backfill at Inco. Together with other Inco personnel, Rudy was a key driver in the implementation of the first paste plants in Canada, and later after retirement from Inco, in other parts of the world as a consultant.

### Qualifications

1966, BSc Mining Eng.  
University of Toronto, Canada

1968, MSc Mineral Eng.  
University of Minnesota, USA

### Professional Status

Professional Engineer, Province of Ontario

Chairman of Canadian Mineral Processors,  
1984

Chairman of CIM Thompson Branch, 1975

Co-chair of Mining/Mineral Processing  
Technical Review Committee for the  
Northern Ontario Development Agreement,  
1992 – 1996 (SME)

### Specialization

Concept development on a wide range of  
tailings and process options

Novel processes involving materials with  
unique characteristics

Program design for problem solving and  
circuit troubleshooting

Process flow diagram and mass balance  
review and optimization

Specification and selection of process and  
instrumentation equipment

Paste and thickened tailings exploratory lab  
program design

Technical reviews

### Notable Projects

#### **Vale Voisey's Bay Paste Fill Feasibility, NL, Canada**

Senior Process Engineer on this FEL2 study overseeing test work, PFD and plant design. Rudy was also involved in the development of the original mill flowsheet for Voisey's Bay while at Inco.

#### **Idaho Cobalt, Idaho USA**

Senior Process Engineer overseeing review of the process flowsheets and P&IDs for the paste plant.

#### **Almina, Aljustrel Paste Project, Portugal**

Senior Process Engineer overseeing the testing, trade off studies and design for this surface paste and underground backfill system.

#### **Goldcorp Red Lake Paste Fill Expansion, Red Lake, ON, Canada**

Senior Process Engineer guiding process upgrades and design of this remote load out trucking system.

#### **Aurizon Casa Berardi, Paste Backfill System, QC, Canada**

Senior Process Engineer designing paste production and transport options for the mine to backfill zones ~5km from the mill.

#### **Suncor Paste Tailings Feasibility, Fort McMurray, Alberta, Canada**

Senior Process Specialist leading this cutting-edge test program and feasibility design to process Suncor's tailings streams (MFT, RT, NRU) into paste.

#### **Zinkgruven Paste Backfill Plant Basic Engineering, Zinkgruven, Sweden**

Senior Process Engineer working as part of the on-site design team in Sweden to develop PFD's, P&ID's, GA's for the paste backfill system.

#### **Bulyanhulu Gold Project, Kahama Mining Corp. Ltd. (Barrick), Tanzania**

Senior Process Engineer leading the process team to design the flowsheet for the world's first operation to pour a true paste on surface.

#### **US Borax, USA**

Process Lead for this pre-feasibility study investigating alternative disposal methods for a boric acid waste stream.

#### **Goro Project, Inco Limited, New Caledonia**

Senior Process Engineer on the project team to design the process and surface piping system for deposition of paste tailings.

**Reichel (Rudy) Tenbergen** P.Eng, M.Sc

**Campbell Mine, Placer Dome, Red Lake, Ontario, Canada**

Senior Process Engineer overseeing the detailed engineering process design for this paste backfill system in Northern Ontario. Scope of work included responsibilities for thickening/filtration circuit design, equipment selection and overall layout review.

**Cotter Corporation, Canon City, Colorado, USA**

Senior Process Engineer conducting on site engineering for the process design and equipment selection for this paste tailings plant which would process uranium tailings for surface disposal.

**Various**

Senior Process Specialist providing review and input on, among others: Aurizon Mines - Casa Berardi (Canada), General Chemicals - Amherstburg (Canada), Pasmenco - Clinch Valley (USA), Anglo Gold - Nova Lima (Brazil), Minsur - Antauta (Peru), CMM - Vacant (Brazil), CEZinc - Valleyfield (Canada).

**Employment Prior to Paterson & Cooke**

1998 to present: **TenTech Process Consultants**, sub-consultant to Golder Paste Technology Ltd. As a Senior Process Specialist, Rudy has been heavily involved in the majority of Golder Paste Technology's projects to varying degrees. His role has varied from Process Lead Engineer, laboratory test program design and supervision, scoping to conceptual study brainstorming, feasibility, basic or detailed engineering or plant troubleshooting.

1990-1998: **Inco Ltd. Concept Design Specialist.** Provided consulting services to various Inco managerial areas and non Inco operations on a wide variety of topics varying from process troubleshooting, process analysis, process research, process design, process start-up, concept plant design and feasibility studies for mineral processing and liaison with outside consultants and engineering firms. Offered key input into the Voisey Bay project including process design, plant layout and equipment selection. Involved in process research, equipment and plant design and optimization for the development of paste backfill and conventional tailings disposal and slurry fill plants (alluvial sand and classified tailings) at Inco mines.

1981-1990: **Inco Ltd. Section Leader, Central Mines.** Responsible for metallurgical control, scheduling and process development for Inco's three integrated milling operations. A major activity consisted of the Mill's Rationalization Project, the mill's component of the Ontario Division's Sulphur Abatement Program. The preparation of a new flowsheet, concepting, testing and installation of large flotation cells and a semi-autogenous grinding circuit at Clarabelle Mill allowed the Froid Stobie Mill and a large portion of the Copper Cliff Mill to be shut down.

1975-1981: **Inco Ltd. Section Leader, Mineral Dressing Test Centre.** Responsible for the activities of the MDTC, a laboratory and pilot plant facility. Major activities included development work related to pyrrhotite rejection to reduce Ontario Division SO<sub>2</sub> emissions, Cu-Ni separation and precious metals recovery from ores, both within the confines of the MDTC and the operating mills. Processes were developed to recover precious metals from smelter and refinery slags and smelter refractory brick. Materials were periodically processed through the facility on a production basis. Spearheaded the development and piloting of the Inco patented SO<sub>2</sub>/air cyanide destruction process, a process that is now in worldwide use at various gold milling operations.

1970-1975: **Inco Ltd. Supervisor, Mineral Dressing Manitoba Division.** Supervisory responsibility for the metallurgical control, accounting, laboratory testing and plant development functions of the Thompson Mill Process Technology group. The major activity consisted of the bringing on-line of the challenging 6,000 tpd open pit orebody. A process was developed to manage a difficult talc problem. Major changes were made to the Thompson orebody flowsheet as well.

1968-1970: **Inco Ltd. Research Engineer, Froid Stobie Mill.** Responsible for metallurgical control and development work. Pebble Mill development work provided the confidence to eventually implement SAG milling at Clarabelle.

## Patents

US 4,102,781, The use of long chain quarternary antistatic compounds to provide flotation selectivity and rock depressions for ultra basic nickel ores. Inventor: Tenbergen.

US 5,820,966, Treatment of smelter gas scrubbing, bleed streams for arsenic fixation and neutralisation. Inventors: Blakey, Kraus, Okita, Tenbergen.

US 5,718,510, Paste Production Storage Mechanism. Inventors: Farmery, Landriault, Tenbergen.

## Publications

Claridge P.G., Tenbergen R.A., *"Pipe Ore Processing Developments in the Thompson Mill"*. Canadian Mineral Processors Conference, Ottawa, January 1975.

Agar, G.E., Kipkie, W.B., Tenbergen, R.A. *"The Separation of Chalopyrite and Pentlandite from Inco's Sudbury Area Ores, Pilot Plant Test Work"*, CIM Bulletin, November 1985.

Lye, K., Mayhew, M., Styles, G., Tenbergen, R.A., *"Computer Control of Flotation Circuits at Frood Stobie Mill"*, Canadian Mineral Processors Conference, Ottawa, January 1985.

Tenbergen, R.A., Throssell, M.A., *"Semi Autogenous-Ball Mill Crushing Circuit Selection for Inco's Mills Rationalization"*, International Conference Autogenous/Semi Autogenous Grinding, Vancouver, September 1989.

Landriault, D., Tenbergen, R.A., *"The Present State of Paste Fill In Canadian Underground Mining"*, Annual CIM Meeting, Halifax, Nova Scotia, 1995.

Naylor, J., Farmery, R., Tenbergen, R.A., *"Commissioning of Paste Backfill at the Macassa Mine with Flash Paste Production in a Paste Production and Storage Mechanism at Kinross Gold Corporation"*, Canadian Mineral Processors Conference, Ottawa, January 1997.

Tenbergen, R.A., *"Dewatering Experience in the Base Metal Industry and Tailings Paste Production for Underground and Surface Disposal"*, Solid-Liquid Separation Short Course, CIM-Metsoc, Quebec City, August 21-22, 1999.

Tenbergen, R.A., *"Paste Dewatering Techniques and Paste Plant Circuit Design"*, Tailings and Mine Waste '00 Conference, Fort Collins, Colorado, January 2000.