The World's Largest Sulfuric Acid Plant ... For Now

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ABSTRACT

The world's largest sulfuric acid plant at 4850 STPD was recently placed into service for Anaconda Nickel LTD located in Murrin Murrin, Australia. This sulfur burning plant was designed and built by Monsanto Enviro-Chem of St. Louis, Missouri. The plant includes the patented Heat Recovery System (HRS) which supplies hot sulfuric acid to an autoclave process to refine nickel as well as intermediate pressure steam to provide power for the refinery complex. The successful operation of the Anaconda plant was based on Monsanto Enviro-Chem's experience in designing and building plants in the range of 3000 to 4000 STPD. This paper will outline the Anaconda sulfuric acid plant and new approaches to designing even larger plants.

HOW IT WAS BUILT

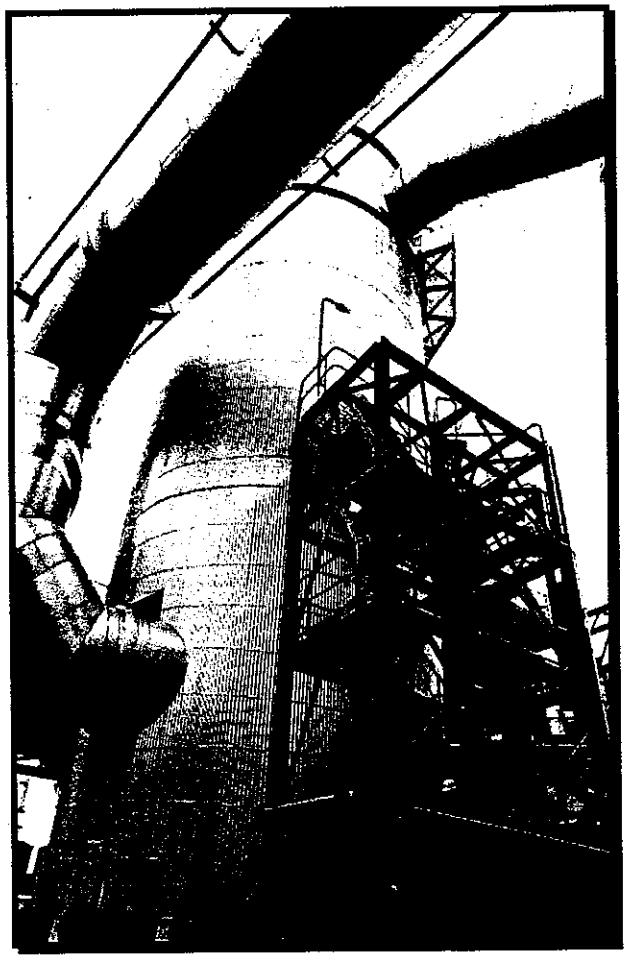
Monsanto Enviro-Chem of St. Louis, Missouri has completed the design, construction and startup of the world's largest single-train sulfuric acid plant. The facility, contracted for Anaconda Nickel's Murrin Murrin site in Western Australia, will maintain a production capacity of 4850 standard tons per day (stpd). Monsanto Enviro-Chem had turnkey responsibility for this plant which includes sulfur melting, filtering and storage. The plant is the source for sulfuric acid and is highly efficient at producing high pressure steam for generating power and heating the autoclaves. Monsanto Enviro-Chem's

extensive experience with designing and building acid plants over 3000 stpd allowed a single train unit to be built instead of two smaller ones which minimized the capital cost. In general, a single train plant will reduce the capital cost by 15%.

Anaconda Nickel's Murrin Murrin site is a low cost, large scale, long life nickel and cobalt resource located 40 miles east of the town of Leonora in the Northern Goldfields region of Western Australia. The entire facility is a US$675 million project owned and managed by Anaconda Nickel Ltd. (60%) and Glencore International AG (40%). Glencore is one of the world's largest diversified physical commodity trading groups and has been appointed exclusive marketing agent for the Project. Glencore has guaranteed the sale of 100% of the metal produced at Murrin Murrin for the life of financing. The project is a "dry" nickel laterite deposit containing a resource of approximately 141 million tons grading 1.01% nickel and 0.06% cobalt. The deposit is well suited to open pit mining methods without the need for drilling and blasting. Processing of the ore will employ commercially proven technology incorporating pressure acid leaching, sulphide precipitation and hydrogen recovery systems. The project will produce approximately 50,000 tons of nickel and 3,300 tons of cobalt in high purity sintered briquette form.

The expected throughput will be 4.1 million tons per annum, giving the project a life in excess of 30 years. There is significant potential for resource expansion through exploration within a 40 mile radius of the Murrin Murrin Joint Venture area. The second stage of the Murrin Murrin plant will expand capacity by 50%, further reducing capital and operating cost per ton of metal produced. Operating costs at Murrin Murrin are expected to be in the lowest quartile in the world. Higher grade mineralisation occurs closer to the surface allowing it to be mined earlier thus increasing the net present value and accelerating the payback period. Nickel and cobalt ore will be processed using commercially proven hydro-metallurgical methods under license from Sherritt. This technology has been in use in Cuba since 1959. Metallurgical test work has determined recovery rates of approximately 92% for nickel and 88% for cobalt. This process specifically requires hot strong sulfuric acid.

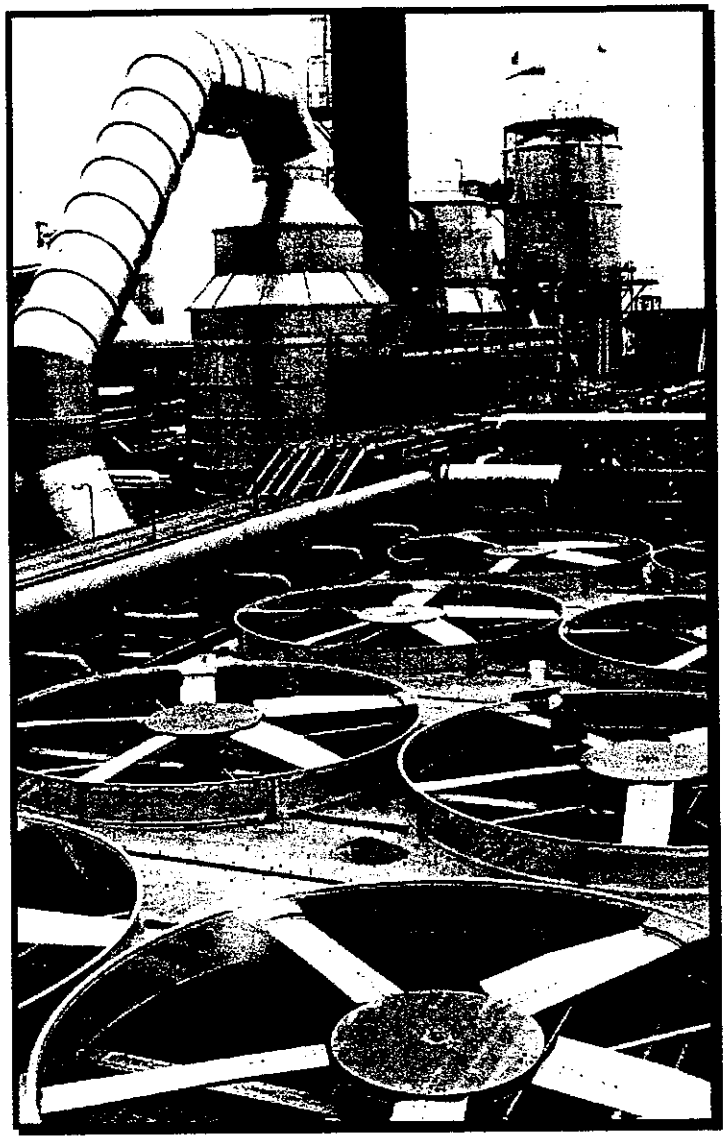
While the acid required for this site could have been provided by building two smaller acid plants with a total capacity of 4850 stpd, Monsanto Enviro-Chem's experience in designing large acid plants created the opportunity to significantly reduce the capital cost and enhance the financial aspect by decreasing the cost per ton of nickel and cobalt produced. Up to now the largest sulfuric acid plants in operation were around 3600 stpd. Monsanto Enviro-Chem needed to develop the design criteria and construction abilities to break this barrier. Adding to the complexity is the construction and startup of the plant half way around the world from the home engineering office. While meeting these constraints, the single train plant needed to maintain the same low cost per ton of acid produced along with very high energy recovery.



The key to Monsanto Enviro-Chem's efficient design is the incorporation of its patented heat recovery system (HRS) which lowers overall energy usage for the project. Not only does Monsanto Enviro-Chem's HRS recover heat to produce steam which is typically lost to cooling water, but it also provides hot strong sulfuric acid directly to the autoclave system. This reduces steam requirements in the autoclaves. Although this is Monsanto Enviro-Chem's 19th HRS installation, considering the enormous size and production capabilities of the plant, the Anaconda acid plant is anything but ordinary.

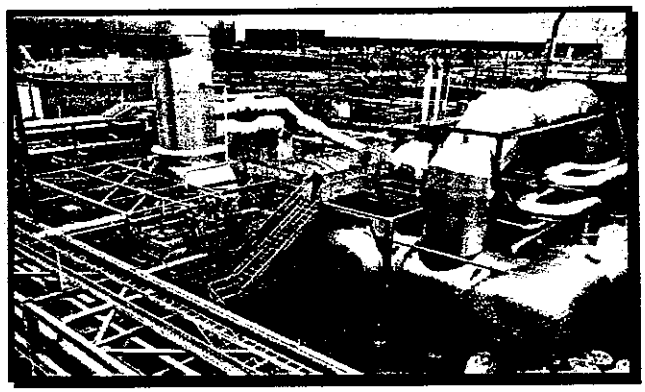
Everything about the plant is big. Both the sulfur burner and the stainless steel converter are the largest Monsanto Enviro-Chem has ever constructed. Analysis of the patterns of gas distribution inside the converter required a special design to maintain even temperatures within a catalyst bed.

Special considerations were given to the plant layout and arrangement of converter inlet and outlet gas nozzles. The acid towers were among the largest ever constructed in Monsanto Enviro-Chem's history. Due to the large physical size of both the ducts and vessels, special considerations were given to the type of inlet and outlet gas nozzles.



The drying acid cooler was the largest ever built by Monsanto Enviro-Chem or anywhere in the world. The use of fin-fan coolers have been used to cool closed loop cooling water instead of a cooling tower or direct air to acid cooling. This method is safer and along with the collection of the majority of the condensate and blowdowns, ensures very little precious borefield water is required. This is positive for the environment and the economics of the project. The plant design utilizes two motor driven compressor/blowers which operate in parallel and increases operational reliability.

The inherent challenges such as the magnitude of the construction and unique geography has spawned innovative thinking in the way projects are designed and executed. In order to meet the project's end in a cost- and time-efficient manner, a number of intriguing design traits new to the sulfuric acid industry have made the Anaconda acid plant project noteworthy.



The use of a single HRS tower with two pump boots, two diluters, and two HRS boilers are just a few of the new design techniques Monsanto Enviro-Chem has applied to the project. This saved on layout space in the plant by not having two towers and reduced the capital cost. Another interesting design was the use of parallel waste heat boilers with a common

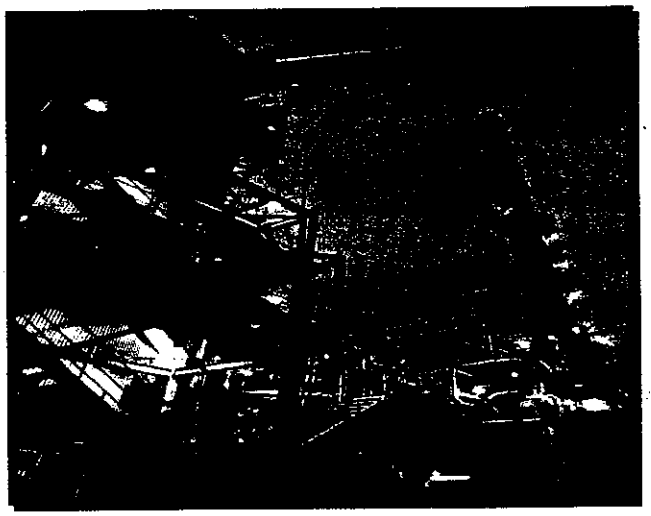
steam drum. The arrangement of the transition from the sulfur burner to the waste heat boilers was analyzed and designed to prevent maldistribution of the gas. Because of the remote location, shop fabrication was maximized with as much of the equipment as possible fabricated in Australia. The sulfur burner shell was completely fabricated in the shop and shipped to the site by truck.

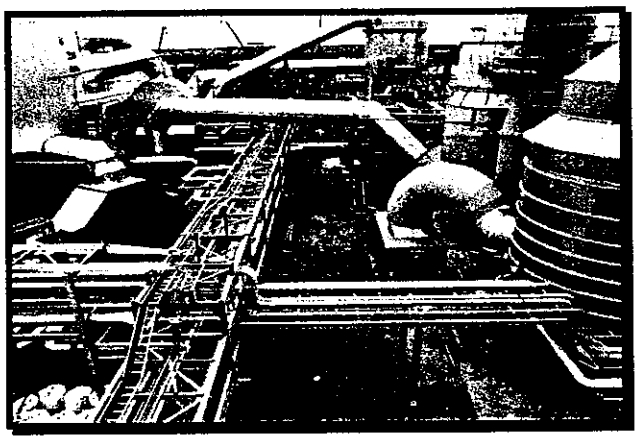
Even though the gas to gas heat exchangers were single units, they were fabricated in large pieces and shipped to the site. Even the tube bundles were fabricated in Australia and shipped to the site.

The many challenges of the Murrin Murrin acid plant project proved to be a valuable learning experience for Monsanto Enviro-Chem, and demonstrated a wide range of capabilities both from a geographic and design standpoint. The project was very successful and rewarding. Monsanto Enviro-Chem found that it could both successfully execute a project on a worldwide basis and meet the unique design needs of the client.

HOW IT OPERATED

In December 1998, the world's largest sulfuric acid plant started up. Sulfuric acid began being produced at a 1700 stpd rate which is about 35% of design capacity. Special design of the equipment and process, including the use of dual compressors, allowed steady operation of the plant at a turndown rate of only 30% of design capacity. When the plant initially started burning sulfur, the level of SO_2 out the stack was an incredibly low 140 ppm versus the government regulation maximum of 3000 ppm which is allowed for no more than two hours. This was achieved by careful control of the gas temperatures and close adherence by the operators to the requirements specified in Monsanto Enviro-Chem's operating manual.





Monsanto Enviro-Chem's special design work and engineering proved to be a complete success as shown by a small difference of only 5-10 F between the converter bed temperatures and the same gases in the duct even at plant rates as low as 50%. The calculations and detail given to the gas distribution inside the converter indicated that the standards Monsanto Enviro-Chem developed were successful on large vessel sizes never seen before by the sulfuric acid industry. After steady operation in the range of 35-70% of design rate, SO_2 gas emissions are well below 100 ppm even though the government regulation for continuous operation is 430 ppm maximum. Rates of over 3000 stpd were achieved before the acid storage tank systems were filled to capacity and could not be used fast enough.

During periods of operation at the higher rates, operators commented how easily the plant was to startup and operate. In fact, to start the plant up only one operator on the DCS and one operator in the field was required. Design steam superheat temperature was met even though the steam side bypass valves were fully open bypassing a majority of the steam. Steam superheat temperature is important for expected power production to be met and should not be any problem at full plant design rate. This is consistent with Monsanto Enviro-Chem's design abilities in other sulfuric acid plants where adherence to proven design standards are met and utilized. This offers the client the greatest operating flexibility and makes for a safe and successful acid plant startup.

As shown by Monsanto Enviro-Chem's success with fabricating and building a plant half way around the world, Monsanto Enviro-Chem has also shown that our engineering standards can successfully provide an operating plant to meet the clients requirements no matter what the plant size is. In fact, the engineering tools and skills developed to meet this challenge for Anaconda can be used to build even larger size plants. Stay tuned for Anaconda II.

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