2002 TAC Environmental Achievement Award Nomination

...innovative Solutions for Rebar Corrosion

Galvashield® Embedded Anodes
Vector Corrosion Technologies

Introduction

Concrete is the most widely used man-made product in the world, and is second only to water as the world's most utilized substance. Slightly more than a ton of concrete is produced each year for every human being on the planet - some six billion tons a year. Concrete is an affordable and reliable material that is applied throughout the infrastructure of our nation's construction, industrial, transportation, defense, utility, and residential sectors.[1]

Vector Corrosion Technologies specializes in products and services for extending the service life of concrete structures subject to deterioration caused by corrosion of the reinforcing steel. Our proactive dedication to solving concrete and corrosion problems is represented by our Corporate Mission Statement.

Vector: **A force dedicated to:**
Solving tomorrow's unique challenges and today's concrete and corrosion problems.

Vector's specialized concrete restoration expertise has been developed from 35^{+} years of service. The primary goal of Vector Corrosion Technologies is to provide expert advice and practical cost-effective strategies and products for mitigating corrosion in concrete structures.

As Vector strives to maintain its cutting edge, and stay on top of new advanced technologies, we have been involved in the development, testing and implementation of many corrosion control systems including the Strategic Highway Research Program (SHRP), investigating and implementing Norcure® Electrochemical Chloride Extraction projects throughout Canada and the United States. In 1996 the Norcure® system received the NOVA Award from the Construction Innovation Forum for innovation in rehabilitation of reinforced concrete structures.

Vector is also heavily involved in the advancement of technology within our industry through active representation on industry organizations such as the American Concrete Institute, International Concrete Repair Institute, National Association of Corrosion Engineers and ISIS Canada - The Canadian Network of Centres of Excellence on Intelligent Sensing for Innovative Structures.

Vector Corrosion Technologies, through research and development and in partnership with Fosroc Internationall Limited, a UK based firm, has developed and markets **Galvashield®** embedded anodes in North and South America as a breakthrough in the corrosion protection of concrete structures. Now even concrete structures suffering from corrosion can be repaired to provide a longer service life.

Vector Corrosion Technologies, under the leadership of David Whitmore, is committed to the principles and ideals of sustainable development, particularly in the area of sustainable transportation. A safe, efficient and environmentally sustainable transportation system is critical to our future prosperity and well-being. The construction and rehabilitation of our infrastructure has significant environmental impacts and any processes that can reduce the frequency of repairs will reduce the cost to the environment. **Galvashield®** embedded anodes are a solution that integrate economic, social and environmental considerations into concrete repair.

A few years ago Vector Corrosion Technologies adopted the tag line *"...innovative solutions for rebar corrosion".* We live that motto and continually search for solutions to provide innovative ways to address corrosion and promote sustainable transportation.

Background

Highways play a fundamental role in transportation. The commercial movement of goods and services and almost all personal trips begin, end or are connected somewhere in the middle by highway travel. A sustainable transportation system that is safe, efficient and environmentally friendly is critical to future mobility. Sustainable transportation is about integrating economic, social and environmental considerations into decisions affecting transportation activity.[2] We must take the initiative and remove every detour, every barrier to ensure this vision is realized.

As a nation, we are taking responsibility for our future and encouraging the integration of innovative technology that meets the demands of the 21st century, into the repair and rehabilitation of bridges, highways, and other reinforced concrete structures that are a vital part of the system.

Manitoba Transportation and Government Services, responsible for the provincial transportation system and services, provides the citizens of (and visitors to) Manitoba with a safe and efficient transportation system. Manitoba's position as a major transportation hub is a significant factor in sustainable economic growth and the social well being of the province.[3]

Manitoba Transportation and Government Services established the 2020 – Manitoba's Transport Vision.[3] This initiative is seeking the views and visions of all stakeholders served by the transportation system as a critical input for defining future investment strategies. This vision recognizes that "much of our highway infrastructure is aging and needs to be repaired, upgraded or replaced." There are over 1200 bridges in the Manitoba highway system alone, with 30% being 40 years or older and requiring repair or rehabilitation; an economical and long-lasting solution must be provided.

The Government of Ontario has made a strong commitment to Smart Growth - a vision for the province that promotes and manages growth to build a strong economy, strong communities and a healthy environment. Five draft *Strategic Transportation Directions* have been developed by the Ministry of Transportation of Ontario. The primary goal of these is "to develop a fiscally and environmentally sustainable transportation system". The Intelligent Transportation Systems (ITS) fits into this process by "taking advantage of short- and medium-term opportunities that can improve existing facilities, often extending their life and making them safer and more efficient".[4]

The Government of Canada outlined in the 1999 Speech from the Throne, a new vision of 21st Century infrastructure to improve the quality of life for Canadians and make a long-term contribution towards a dynamic economy. The Infrastructure Canada - Alberta Program (ICAP) is implementing this national vision in Alberta through the funding of municipal infrastructure. The ICAP agreement was signed October 10, 2000 and the program runs until March 31, 2006. All three levels of government played an important part in the design of this new program. Included in the overall objectives of the program is:

- Improvement of community infrastructure, (e.g., construction or rehabilitating traditional transportation infrastructure, increasing community safety, supporting Canadian heritage and culture, increasing access to local recreational facilities, etc.);

- Building 21st Century infrastructure, (e.g., encouraging innovation, increasing partnerships, encouraging use of new approaches and best practices, more efficient use of existing infrastructure).[5]

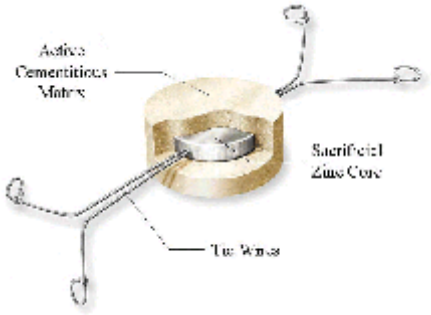
All over North America there is evidence of concrete in decay. The single most detrimental factor leading to the deterioration of concrete structures is corrosion of the reinforcing steel. Conservative estimates have found the total cost related directly to corrosion of reinforced concrete structures: bridges, roadways, parking garages, and buildings, in the industrial sector in the United States is more than $80 billion USD each year. Estimates for Canada, are approximately 10% ($13 billion CDN) of US expenditure, whereas worldwide costs are much

greater.[6] We can remain complacent, or we can take action to reduce congestion associated with bridge and highway maintenance projects and lower the life-cycle costs of our transportation infrastructure.

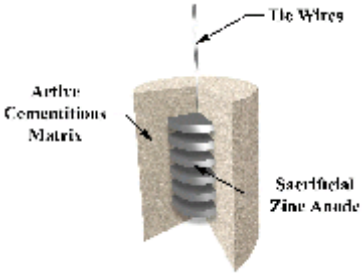
The two most common sources of corrosion are carbonation and chloride attack. In both cases they lead to the formation of corrosion sites on the steel. During this process rust is formed which occupies two to ten times the volume of the original steel. This creates expansive forces within the structure, which eventually cause cracking and spalling (destruction of the concrete). Common sources of chloride-induced corrosion of bridge structures are deicing salts and marine exposure.

Description of Galvashield® Embedded Anodes

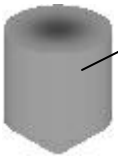
The **Galvashield®** embedded anode consists of a zinc core, which is encased within a cementitious shell. The activated mortar contains additives that regulate the corrosion of the sacrificial zinc core. These anodes are incorporated within reinforced concrete to reduce corrosion of the reinforcing steel and extend its service life. The **Galvashield®** embedded anode is available in three different variations to suit specific protection applications.



The **Galvashield® XP** embedded anode consists of a zinc core which is cast around a pair of steel tie wires. This unit is encased within a cementitious shell. The tie wires extend out opposing sides of the 63 mm diameter x 28 mm high anode to enable it to be tied to the reinforcing steel. The XP anode is generally used for patch repairs following excavation of the chloride contaminated concrete.



The **Galvashield® CC** embedded anode consists of a zinc core encased in a cementitious mortar with only one steel tie wire. This 65 mm long x 44 mm diameter cylindrical anode is installed quickly and easily in 2 inch diameter holes drilled into existing structures. The CC anode protects areas where contaminated concrete can not be removed.



"SMART ZINC"

Through research and development in Manitoba, Vector Corrosion Technologies developed the **Galvashield® SB** "Silver Bullet" embedded anode utilizing patented "Smart Zinc" technology, which is the newest product in the **Galvashield®** line. This 25 mm long x 19 mm diameter cylindrical anode is easily installed into ¾ inch holes drilled in chloride contaminated or carbonated concrete. The cementitious shell has been eliminated through the use of "Smart Zinc" making this anode very compact, and much simpler to install. The SB anode is suitable for thin sections and protects areas where contaminated concrete can not be removed.

Prior to general release in 2003, this anode had only been used in specific demonstration projects and field trials. One project, completed in August 2002, was the installation of 300 anodes in 10 concrete girders on the Trans-Canada Highway overpass at the east end of the town of Portage la Prairie, Manitoba.

Design Philosophy

The philosophy surrounding the use of the **Galvashield®** technology is to use a natural process to improve the condition of existing, deteriorated structures, restoring them to a greater level of serviceability. The primary design application of these anodes is for concrete rehabilitation and service life extension projects.

Galvashield® embedded anodes extend the life of concrete structures, resulting in less frequent repair and replacement. Construction and large scale repair often have a significant impact on the surrounding environment. Concrete structures such as bridges and dams are often built to span delicate regions such as marshes and waterways, where plant and animal life are particularly sensitive to change.

Testing has shown **Galvashield®** embedded anodes reduce corrosion by 85%, effectively extending the structure's life sixfold. This means the installation of anodes in a structure expected to maintain its integrity for three years, extends its service life to 18 years.

The anode takes advantage of the natural galvanic differences which exist between dissimilar metals. Since the sacrificial anode core (zinc), is more reactive than the reinforcing steel to which it is attached, the anode will corrode preferentially to the reinforcing steel. This extends the life of the reinforcing steel by 10 to 20 years, and aids in maintaining the integrity of the structure. As a result, repairs and major rehabilitation of concrete structures, such as bridges, buildings and industrial facilities are deferred, saving expenditure of manpower, energy and materials, thus mitigating probable consequences to the environment, the economy and human health and well-being.

In order to meet increasing demand for **Galvashield®** embedded anodes in North America, Vector expanded its facilities in December 2001 to bring the manufacturing of **Galvashield®** embedded anodes in-house. New staff were added to the Vector team to enable the timely supply of anodes to a wide variety of clients. The new manufacturing facility, based in Winnipeg, provides all production required for North and South America. Vector Corrosion Technologies has become a recognized leader in innovative concrete repair technology. We also continue to provide quality testing and investigation of corrosion and concrete related problems to protect our nations' infrastructure.

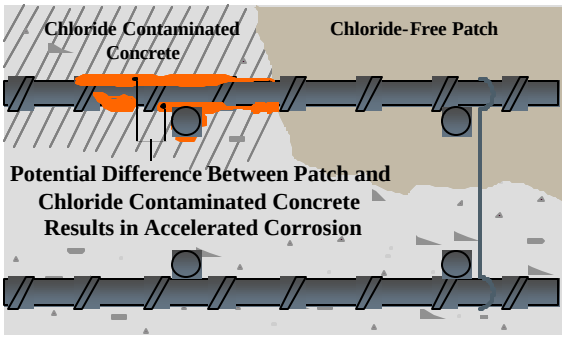
Concrete bridges are used by our modern world's transportation infrastructure to maintain an even and safe flow of the many commercial requirements of business, as well as the free movement of society to better enjoy their quality of life. Often taken for granted, these important links in the highway system are an integral part of modern life. An improved and more efficient national highways system *reduces costs* for delivery and delivery times associated with unfinished and finished products; improves access to markets; allows for strategic location alignment decisions.[2]

Bridge decks are subject to freezing as temperatures drop and any moisture quickly turns to dangerous ice. To combat this, maintenance crews apply de-icing salts to melt the ice and maintain safe driving conditions. Over time the salt penetrates through the porous concrete. When the concentration of salt exceeds a given

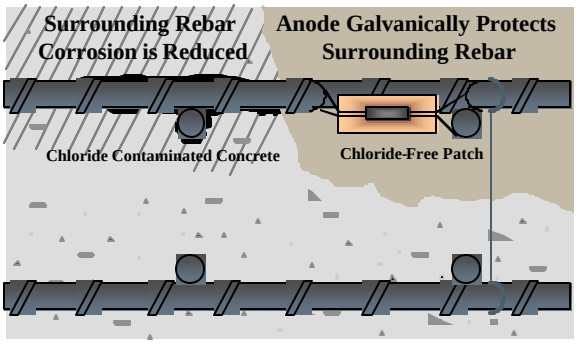
threshold at the surface of the reinforcing steel, the steel begins to corrode and expand causing the concrete to crack. This diminishes the structural integrity of the bridge resulting in unsafe conditions for drivers.

Contribution Made to the Protection and Enhancement of the Environment

A vast and aging concrete infrastructure has created a need for new and improved methods of rehabilitation rather than outright replacement. While early damage is often not a serious structural concern, corrosion acts like a disease and must therefore be treated or it will grow to become a significant structural problem.
In many cases, a "chip and patch" approach to concrete repair is adopted. This procedure entails removal of damaged concrete, cleaning the reinforcing steel, and patching the repair area with concrete or a special mortar. Repairs of this nature will in many situations actually accentuate corrosion in the reinforcing steel adjacent to the repair area. This phenomenon is often referred to as "Ring Anode" or "Patch Accelerated" corrosion. **Galvashield®** embedded anodes are designed to neutralize or slow down new corrosion cells, which would otherwise develop around a patch, thereby extending the service life of the repair.
Adopting embedded anodes into an existing patch repair program requires a minimum of additional work, little



"Ring Anode" Corrosion (without Galvashield® XP)



Galvashield® XP Reduces "Ring Anode" Corrosion

expense and greatly enhances the longevity of repairs. This proactive approach to concrete repair minimizes waste material and debris from construction chemicals and equipment, the use of new material (cement, steel and aggregates) and the energy required to rebuild the structure, as well as other forms of air, water and soil pollution which often remain in an ecosystem after construction is complete.

Cement production is the most energy-intensive phase of the concrete production chain. Cement production requires high process temperatures to produce necessary chemical transformations. Approximately one ton of carbon dioxide is emitted for every ton of clinker produced. Roughly one-half results from the combustion of hydrocarbon fuels, and the remainder comes from the chemical decomposition of limestone, the principal raw material used in cement making.[1]

Galvashield® anodes are suitable for deck repairs, joint replacements, pre-stressed & post-tensioned repairs, columns, beams and interface applications between new concrete and existing chloride-contaminated concrete where accelerated corrosion can occur. A simple, inexpensive product such as the **Galvashield®** embedded anode aids engineers and owners in all sectors.

The additional benefits of using these anodes to extend the service life of concrete structures include the reduction of:

- demand for new materials
- demolition costs
- disposal of concrete rubble upon demolition
- traffic congestion
- energy required in the production and transportation of cement,steel and aggregates
- greenhouse gases, e.g. production of cement and steel result in the generation of large amounts of CO_2
- life-cycle costs for concrete structures

The protection offered by **Galvashield®** embedded anodes helps maintain the integrity of concrete structures thereby preserving our bridges and highway system for the citizens of Canada and future generations. To this end, Vector is vigilant in protecting the environment and upholding all environmental regulations and standards.

Environmental Management

As stated in our Environmental Management Policy:

Vector Corrosion Technologies is committed to a safe, healthy and sustainable environment. To this end:

- **Vector** will be vigilant in protecting the environment and incorporating all Legislated Environmental Regulations.
- **Vector** employees are trained to recognize environmental concerns and to be proactive with positive solutions.
- **Vector** employees are required to identify, assess and control risks that may present short-term or long-term exposures to people, property and/or the environment.
- **Vector** employees, from Senior Managers to new recruits, are expected to govern themselves in a manner consistent with this Policy.
- **Vector** employees are required to report unresolved environmental issues and concerns to the President without delay.
- **Vector** Sub-contractors are advised of our concern for the environment and are required to operate in a manner consistent with this Policy.

Vector received the 2002 Sustainable Development Award of Excellence from Manitoba Conservation in recognition of **Galvashield®** embedded anodes as a technology that effectively implements the principles and guidelines of sustainable development. Vector is proud to be a leading force for "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[7]

Waste Minimization

Galvashield® embedded anodes minimize waste by saving large amounts of concrete and steel through the efficient use of minimal amounts of zinc, a recyclable resource. The many resources that are required for continuous repair or replacement such as the disposal of old concrete and the supply of new concrete and new reinforcing steel are minimized. In addition, this reduces the amount of pollution and physical disruption to the local environment by increasing the interval between successive repairs.

Galvashield® embedded anodes are a non-hazardous product. Manufactured of common construction materials they are installed simply without complex equipment or processes. Depending upon a project's design parameters the anodes will normally operate for a period of 10 to 20 years. Once installed, its zinc is converted into a stable, non-hazardous zinc corrosion product. After its service life is complete, the anode remains are dormant and concealed within the concrete, having no maintenance or special disposal requirements.

The cost and availability of disposal sites for waste created by concrete repair projects is becoming a significant issue in Canada and the United States. By reducing the amount of repairs required, **Galvashield®** embedded anodes are a solution to this problem.

Responsible Use of Technology

Galvashield® embedded anodes maintain the well-being of this small portion of our planet through responsible use of technology. The anodes can also be installed in new concrete structures mitigating corrosion effects when they begin to occur, thus delaying the economic and environmental costs of concrete repairs. **Galvashield®** embedded anodes are a part of the shifting attitude towards preserving and extending the life of our infrastructure, both new and existing. The mean age of structures in North America is at the point where a large proportion are now considered deficient, and their rate of deterioration is increasing exponentially. The condition of these structures will continue to degrade and affect future generations if action is not taken as required to mitigate the problem. Wise investment in technology delays or prevents much larger costs for future generations.

Resource Management

Galvashield® technology delays or negates the consumption of additional materials, energy and resources required to repair or replace concrete infrastructure. The use of **Galvashield®** embedded anodes reduces the number of concrete repairs required thereby reducing the harmful effects to our environment.

The main component of **Galvashield®** embedded anodes is the zinc core. Zinc is a recyclable resource. Over one third of zinc consumed in North America is recovered from old cars, bridges and buildings, among other sources .[8]

Zinc used in the manufacturing of **Galvashield® SB** embedded anodes is a zinc powder. The chemical composition of this powder is of importance due to the hazards of breathing in impurities. The zinc used by Vector is UltraPure™ zinc powder, which conforms to ASTM D520 Type III. "What makes UltraPure™ unique is its environmental friendliness," said Ken Edwards, Purity Zinc Metals' Chief Executive Officer. "It is safer for the worker who uses it and it is safer for the environment." According to Edwards, UltraPure™ zinc powder, which conforms to the newly adopted Type III, significantly reduces environmental and worker exposure to lead and cadmium, which are dangerous in high concentrations. These concentrations are reduced by 85% and 99% respectively in the UltraPure™ grade. Lead is found in 100 parts per million (ppm) in the ASTM Type II standard but in only 15 ppm in UltraPure™ zinc powder. Cadmium registers at 100 ppm in ASTM II but is reduced to 1 ppm in UltraPure™. UltraPure™ is the highest quality commercially available zinc powder.[9]

	ASTM D520 Type II	**Purity Zinc Metal's UltraPure™ Grade**
Lead, calculated as Pb, max %	.01 (100 ppm)	.0015 (15 ppm)
Cadmium, calculated as Cd, max %	.01 (100 ppm)	.0001 (1 ppm)

Societal Benefits

A strong infrastructure will carry the goods and services required to promote a healthy economy, allowing the citizens of Canada to access hospitals, visit zoo's, go to school and expand their horizons through travel, all necessary elements to promote a feeling of well-being in any society.

Quality transportation routes are essential to the working of modern society. Repeated concrete repairs can cause traffic congestion and make for many aggravated drivers. Noise pollution with heavy machinery and jack-hammers as well as the release of significant amounts of dust and impurities into the air is detrimental to human health and social well-being. By eliminating the need for continual repair, **Galvashield®** embedded anodes support an efficient, construction free transportation system.

Degree of Innovation used to Address Environmental Problem or Issue

Research and Innovation

Zinc has long been used to protect steel from corroding. In the 1800's ship builders started adding metals of higher electronegativity to divert corrosion on the hulls of their ships. Zinc alone in a concrete environment would not remain active long enough to be useful. It is the innovative addition of the active cementitious matrix around the zinc that keeps the zinc active long enough to be of value in this application. Prior to the use of **Galvashield®** embedded anodes, the preferred method once corrosion was initiated, was to chip out the damaged concrete and replace it with a patching compound, only to have the corrosion cell re-develop shortly thereafter to start the cycle once again.

Galvashield® embedded anodes operate on simple corrosion principles. Their performance is real and tangible, their operation and effect can be monitored using well-established tools and practices. Laboratory research has shown that these anodes will reduce corrosion of the reinforcing steel by approximately 85 percent.

The **Galvashield®** technology demonstrates how, through research and innovative techniques, solutions to problems thought to be insurmountable can be overcome. Monitoring the anodes at several project sites, maintains assurance that this technology continues to benefit the structure. Vector's research and development department carries out testing through the monitoring of anodes installed in various project sites as well as in accelerated laboratory studies. This ensures that informed decisions are provided for each unique application.

Vector Corrosion Technologies innovation has resulted in four patents being issued to David Whitmore, P. Eng., President of Vector Corrosion Technologies.

Vector Corrosion Technologies' dedication to producing innovative technologies for corrosion mitigation has led to several developments including the invention of a new product, **Galvashield® SB**, by the Vector team in Winnipeg. These anodes can be installed in drilled holes and do not require open excavation thus further reducing the effects of concrete repair on the environment. This procedure reduces noise pollution and requires little concrete removal.

Vector Corrosion Technologies is committed to verifying the performance of their products and services and updating valued and respected clients with this information. In order to accomplish this, products are periodically evaluated by various research and education foundations who provide an unbiased opinion of the effectiveness of these innovative technologies.

The Concrete Innovations Appraisal Service (CIAS) released an appraisal report, Galvashield Embedded Galvanic Anodes for Repair of Concrete, CIAS Report: 01-1 in July 2001. The principle use of the report is as neutral documentaiton to help technical committees of the Amercian Concrete Institute (ACI) and users of appraised technologies to better understand technologies being considered.

The conclusion of the report states:

"Galvashield® Embedded Galvanic Anodes seem to be a practical, inexpensive approach to solve or at least reduce this problem. Being based on a proven technology, it would be a logical conclusion that they should work. The technology offers an easy-to-understand concept, which gives the client confidence in the capability of the repaired structure to perform its intended use.

This technology seems to offer the best alternative at a low cost to extend the life of concrete repairs."[6]

Financial Implications Associated with the use of Innovative Technology

The building industry accounts for 20 to 40% of the total industrial production in most countries. Since the concrete industry is an important part of this, the development of new technologies for protection of concrete is of particular interest when considering the world's sustainable development. While rehabilitation is often the most cost-effective strategy, the durability of repairs plays a significant role in determining which alternative will be the most economical.

Deterioration caused by the corrosion of reinforcing steel in concrete structures has been recognized as one of the greatest maintenance challenges facing owners and engineers today. Normal patching procedures simply shift the corrosion reaction to adjacent concrete areas, thus creating a continual battle in which repair crews chase the corrosion problem around the structure resulting in an endless series of repairs. When comparing the cost of installing anodes in the structure to the costs of continuous repair, it is obvious that the **Galvashield®** technology is a more beneficial and longer-term solution than the previously preferred method of chip and patch repairs.

Even in small repair projects, the use of **Galvashield®** embedded anodes provides a cost-effective alternative to the conventional method of "chip and patch" repairs. Installing anodes in concrete is much less expensive than having to come back and repair that same area again. Especially in the case of concrete that has already been excavated for repair, the additional cost to install anodes is a fraction of the cost of the repair itself.

The expenditure associated with incorporating anodes into concrete patch repairs is merely the cost of the anode and any additional labour cost to install them (installation typically takes less than a minute per anode). Adopting **Galvashield®** embedded anodes into an existing patch repair program requires a minimum of additional work, little expense, and can greatly enhance the longevity of the repairs.

Considering that conservative estimates have found the total cost of corrosion in the industrial sector in the USA to be more than $300 billion each year and that 25 to 30% of this cost is related directly to corrosion of reinforced concrete structures: bridges, roadways, parking garages, and buildings, the concrete repair industry is facing a major challenge. Galvashield® addresses the need to repair, rehabilitate and protect the current stock of concrete structures in order to prolong their service lives in an economical fashion.[6]

Taking a proactive approach and incorporating anodes at the design stage of construction, can extend the service life of new structures for minimal cost. By working in partnership with government agencies, owners and engineers, Vector combines individual strengths to overcome the challenges corrosion presents.

Vector continues to build and grow to ensure a secure future for both the firm and all its employees, and continues to refine the organization and better define the roles employees play in the day-to-day operation of the firm.

As part of the work of refinement and definition, a five-year Business Plan 2001 - 2005 is in place to ensure that Vector is ready to face opportunities and challenges, not only for this year, but for the years beyond.

Vector Corrosion Technologies' staff of senior managers, engineers and research and development professionals are diligent in their quest for providing clients with *"innovative solutions for rebar corrosion"*. The goal is to understand the client's needs and design a corrosion protection strategy that best suits those needs.

Overall Applicability to Transportation

Sound Economic Development

The **Galvashield®** technology was developed as an economically viable option when dealing with the problem of corrosion in concrete. For example, in the expansion of the Port Mann Bridge located on the Trans-Canada Highway in the East End of Greater Vancouver, an additional lane was added onto both sides to lessen the increasing traffic congestion. This addition created a 1-mile long joint along each side of the structure.

Galvashield® XP *anodes installed along joint interface*

Galvashield® XP embedded anodes were chosen for this project because the B.C. Ministry of Transportation desired a product that would protect the joint between the new lane and the existing structure, and eliminate the need to shut down traffic for repairs. The maintenance-free aspect of the anodes, combined with their low installed cost made the anodes an extremely attractive option for such an important application.

The overall project cost was projected to be approximately $35 million CDN, with the anode portion being only $100,000 CDN (including installation costs) for 4,500 anodes. The final cost of the anodes translates to 0.3 percent of the total project cost, a small price for 10 to 20 years of corrosion protection.

Through investment in research and development Vector Corrosion Technologies develops new methods and materials to protect our nation's infrastructure. Enhanced infrastructure and national highways generates economic expansion by facilitating the expansion of commerce. This creates higher employment and therefore larger tax revenues to government as a result of increased economic activity.[1] It is obvious that the impact of a technology that improves the service life of vital structures reaches far beyond the benefits to the structure alone.

CC Technologies Laboratories, Inc. conducted a study entitled "Corrosion Costs and Preventative Strategies in the United States" which was supported by the U.S. Federal Highway Administration and the National Association of Corrosion Engineers. A recent article published in Materials Performance featured the major findings of the study and concluded that "the bottom line is that the use of appropriate corrosion prevention and control methods protects public safety, prevents damage to property and the environment, and saves billion of dollars."[10]

Vector's vision for the future is to solve tomorrow's unique challenges and today's concrete and corrosion problems.

...innovative solutions for rebar corrosion

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