

# A Packaging Concept for the New Millennium

BORIS A. MIKSIC, FNACE, AND ROBERT W. KRAMER

Vapor-phase corrosion inhibitor stretch film packaging is ready to meet the packaging challenges in the new millennium. While polyethylene in the form of stretch film for bundling purposes has been used throughout industry for more than 25 years, the inclusion of environmentally friendly corrosion inhibitors through an innovative technology opened doors in the steel industry.

**D**uring the past 3 decades, steel packaging remained basically unchanged using various combinations of kraft paper, corrugated kraft, reinforced kraft papers with polyethylene (PE) laminates and coating, kraft fiberboard, and metal fabricated containers. Commingling materials do not meet demands for recycling or even source reduction to achieve environmental objectives. The new millennium will entail greater focus on environmental concerns and require that all materials produced be recycled.

## Inhibited Stretch Wrap Packaging

This concept emerged in the early 1990s when Cortec Laboratories began researching the feasibility of introducing non-sodium nitrite corrosion-inhib-

iting technology to plastic films. Working with B.H.P. Steel Group and Australian Challenge (Victoria, Australia) researchers found that the technology not only provided corrosion protection but made possible development of new packaging equipment. For nearly 7 years, the company has continued to expand its packaging with vapor phase corrosion inhibitor (VpCI) film, achieving dramatic reduction from prior corrosion claims with standard kraft/poly steel wraps.

At the same time, International Packaging Machines, Inc., of Naples, Florida, built the world's largest stretch wrapper for Sumitomo Light Metals of Nagoya, Japan, to wrap 23-t (20,866-kg) coils of aluminum, 8-ft (23-m) diameter, loaded eye vertical on 2.5-t (2,268-kg) steel platforms without steel banding. Armed with this information, the researchers began developing the high-performance stretch film that Cortec Corp. subsequently patented<sup>1-19</sup> and targeted for tinplate and other metal packaging applications where superior corrosion protection and holding force are critical.

The holding power of stretch wrap through its elasticity curve was far greater than that of steel strapping. The normal cross pattern of two steel bands with break strength of 10,200 lb (4,627 kg) used to secure primary tinplate coils on skids is overshadowed by 120,000-lb (54,432-kg) break strength of 40 wraps 2-mil (50- $\mu$ m) film stretched 150% (Figure 1). The unique linear molecular structure of plastic stretch film, particularly the use of advanced resin compounds, makes possible superior load-holding force in stretch wrap applications.

Multimetal VpCIs are compounded in the resins used to extrude the film. These VpCIs are chemical compounds that vaporize from the film and condense onto the surface of the metal, forming a thin, monomolecular, uniform, and effective corrosion-protecting layer. It protects even in recessed areas where the film is not in direct

contact. The patented Cor-Pak VCI Stretch Film<sup>†</sup> manufactured with linear low-density PE resins (LLDPE) is transparent, fully recyclable, and nontoxic, with pre-stretch capability up to 350%. This U.S. Food and Drug Administration (FDA)-approved technology makes the film ideal for tinplate and food-processing applications.

## System for Tinplate Coils

While the aluminum industry used stretch film for years as an overwrap, Weirton Steel Corp. (Weirton, West Virginia), perfected the viable system for tinplate coils.

The concept to stretch wrap tinplate coils was considered through all levels at the company as a potentially significant cost-reduction alternative. A series of trials was conducted early in 1994 using an IPM Model R0-88<sup>†</sup> rotary overhead semiautomatic stretch wrapper over a 6-month period with coils averaging 54-in. (137-cm) diameter on 56-in. (142-cm) skid platforms.

Coils of 12-t (10,886-kg) weight wrapped with 2-mil film pre-stretched 250% developed a strong force-to-load strength with 38 to 48 wraps. It became evident in the trials that coil size, as related to skid size, posed a particular problem. The larger the gap between coil and skid corner, the greater the propensity for film puncture and failure at the corner.

Various methods to resolve this problem ultimately resulted in a 2-in. (5-cm) corner radius specification on all skid corners. Trial shipments confirmed projected holding force as well as handling and corrosion protection. Specific trials to evaluate dew point conditions developed some condensation situations, but the VpCI prevented corrosion.

Following extensive trials, the company's management approved purchase of a fully automatic rotary overhead stretch-wrapping machine,

FIGURE 1



(a) Steel banded scroll load tinplate.



(b) Roped stretch wrap scroll tinplate.

The linear molecular structure of plastic stretch film allows for strong load-holding force.

which went online January 1995 in placement over an existing coil packaging conveyor line.

It quickly became apparent why pioneering poses greater risks than following prior knowledge. While the American Iron & Steel Institute (AISI)-approved standard skid design is configured for steel strapping, no changes were contemplated for stretch wrapping. Sharp corners became a critical issue as film force-to-load strength was so great that the stretch film began migrating up off the corners and punctured when the gap between coil and skid corner increased because of coil diameter variation. Without positive hold at all corners, holding strength was compromised greatly, causing coils to shift on the skids. Minor modifications were made to resolve these issues. A 2-in. radius on skid corners minimized film puncture, and a 1-in. (2.5-cm) bevel at the top of skid runners flush with lead platform boards allowed film to lock the coil to the skid.

The wrapping sequence originally programmed was further enhanced by the company's Tin Mill engineers to rope or neck down the film width for

improved holding force with fewer wraps. Alternating the wrap sequence to cover two corners, then cycling up around the coil opposite the wrapped corners, and repeating them for all four sides, became a major improvement. The program basically consists of five wrap cycles for each side of the skid, five wraps cycling up on the coil, eight wraps at the top and five down, and two final wraps around the skid perimeter to finish. These 40 wraps have proven more than sufficient to hold 12-t coils on the skid in conjunction with a 1/2-in. (1.3-cm) felt pad of 5-lb (2.2-kg) density under the coil to dampen vibration. Average film consumption varies between 1.7 and 2.5 lb (.77 and 1.1 kg) depending on coil and skid size.

Since the company went into full production with stretch wrap film packaging in September 1995, it has shipped in excess of 300,000 coils both domestically and export without failure.

## CONTROLLING DAMAGE AND RUST

Figure 2 shows the prepared coil before and after stretch wrapping. The purpose of the package is to protect the coil from damage and rust. Designed to be as airtight and waterproof as possible, each component is there to maintain this condition through all real-world conditions. The VpCI used in the package is not the cure all if the product and package are compromised. It is the important last line of defense that must be understood for proper application. As shown in Figure 3, the steel company has achieved significant reduction in rust claims since the introduction of its stretch wrap pack. The improvements in damage control were adversely impacted in 1998 because of extraordinary conditions at one customer. Currently, the company is focusing on training warehouse and shipping personnel to achieve optimum results. It has worked closely with customers to institute new procedures. In severe situations, it has

<sup>†</sup>Trade name.

**FIGURE 2**



(a) A 12-t coil is shown before and after stretch wrapping.

used third-party consultants to investigate and resolve problems. Figure 4 illustrates progress made by the package design and joint effort with shippers, warehouse, and customers.

Considerable effort was given to trucking firms to help them better understand the handling of tin plate. Manuals with specific instructions were developed for use in training. Random inspections were conducted to ensure directions were being followed. The company firmly believes that 100% use of web strapping of loads on trucks and rail would eliminate most damage. In the meantime, rubber-backed steel-edge protectors provide the best defense against chain damage. Figure 5 shows what can be accomplished by working closely with a customer. The impact of the 1997 damage increase resulted in a new turnover installation at the customer with good results and no rust in 1998. This customer fully expects further reduction in damage.

### NEW EXPORT STRETCH PACK

Deviating from “canned” metal case export pack specifications posed a real challenge for the steel company. A “plastic case” package was developed for the company by R.I.G. Packaging (Pittsburgh, Pennsylvania), to integrate into the existing stretch system. Acceptance problems and damage caused by poor handling resulted from lack of understanding of tin plate. A summary of a critical items list was developed and

distributed to all parties involved, including customers and insurance carriers. So far, the company reports the export pack has performed very well, reducing material and claims costs.

Construction of the export case is formed in two parts. The top cap has a 20-mil (508- $\mu$ m) black polypropylene (PP) circle glued to a double-wall corrugated disc in between and sandwiched at the outer edge of a black plastic corrugated edge protector. This cap is placed down over a Super A Flute<sup>†</sup> corrugated fiberboard circumference or “belly wrap” that is also wax-coated to provide an extra moisture barrier. The export case is placed over and in addition to the standard VpCI stretch pack. The load is then stretch-wrapped a second time for shipment.

### New Markets— New Opportunities

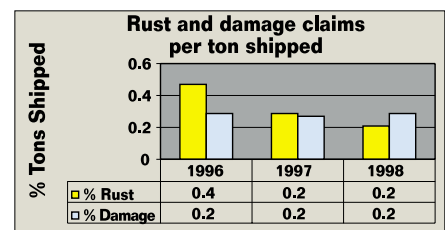
Proven success at steel industry firms spawned new applications at Dofasco, Inc. (Hamilton, Ontario, Canada), Thomas Steel Strip (Warren, Ohio), Interstate Steel (Chicago, Illinois), National Rolling Mills (Philadelphia, Pennsylvania), and Ovako Steel (Sweden), all of which have benefited from elimination of corrosion claims. Wherever there is metals processing, there is opportunity for stretch packaging. For example, TPC Metals (New-

<sup>†</sup> Trade name.

ark, New Jersey) now packages all loads by stretch-wrapping—even type C loads of uneven size slit mullets for export that would otherwise be impossible to securely band on skids. BMAT (formerly U.S. Can) (Chicago, Illinois) transitioned from kraft/poly steel wrap to VpCI poly bags to its current use of VpCI stretch film for all undecorated can stock. It is in the process of converting all litho decorated accordingly.

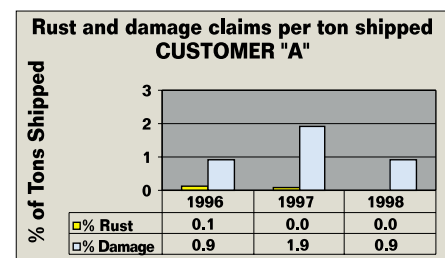
Trials currently underway at Crown Cork & Seal (Concord, Ontario, Canada) for wrapping cut-length decorated tinplate have been designed to utilize the “roping” technique with VpCI stretch film. This procedure entails programming the wrapping sequence similar to Weirton’s work with primary coils, whereby the film is necked down or narrowed to a rope appearance and placed over the top corners for increased vertical holding force.

**FIGURE 3**



A company achieved significant reduction in rust claims after using stretch wrap packing for corrosion control.

**FIGURE 4**



Joint efforts with shippers, warehouse, and customers resulted in new procedures to successfully use stretch wrap packaging.

The introduction of molded plastic skid platforms should further enhance the concept of stretch film packaging. New designs accommodate the increased use of stretch wrap/roping.

## Environmental Advantages

Although improved cost effectiveness would alone justify this new packaging concept for the new millennium, other advantages could become equally or perhaps even more significant in the future. Recyclability of environmentally friendly VpCI films will become more important in the future, particularly as manufacturers become responsible for materials through their useful life cycle and disposal. For the steel industry, it becomes possible to extend a commitment to environmental objectives and recycling to not only the product but also the package. With a simple slice of a razor-cutting knife, <2-lb (.91-kg) film is easily peeled from the load, rolled into a small ball, and tossed into the recycling bin.

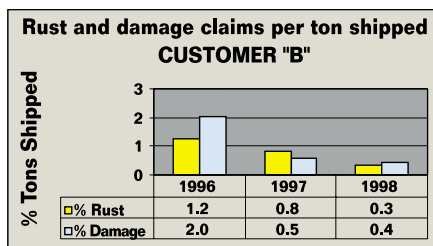
## Acknowledgment

The authors thank the individuals, companies, and institutions mentioned in this article for their vision and commitment to achieve better corrosion prevention and control.

## References

1. B.A. Miksic, "Vapor Phase Corrosion Inhibitor Desiccant Material," U.S. Patent No. 5,139,700.
2. B.A. Miksic, "Vapor Phase Corrosion Inhibitor Desiccant Material," U.S. Patent No. 5,209,869.
3. "Vapor Phase Corrosion Inhibitor Desiccant Material," U.S. Patent No. 5,320,778
4. "Method of Inhibiting Corrosion of Concrete Reinforcements," U.S. Patent 5,326,529.
5. "Vapor Phase Corrosion Inhibitor Desiccant Material," U.S. Patent No. 5,393,457.
6. "Vapor Phase Corrosion Inhibitor Desiccant Material," U.S. Patent No. 5,332,525.
7. "Vapor Phase Corrosion Inhibitor Desiccant Material," U.S. Patent No. 5,344,589.
8. "Anti-corrosion Plastic Film Containing Recycled Resin," European Patent 94304176.4.
9. "Vapor Phase Corrosion Inhibitor Desiccant Material," South African Patent No. 94/1033.
10. "Vapor Phase Corrosion Inhibitor—Desiccant Material," U.S. Patent No. 5,422,187.
11. "Anti-corrosion Plastic Film Containing Recycled Resin," Australian Patent No. 675317.

FIGURE 5



A new turnover installer solved a rust problem for one facility.

12. "Vapor Phase Corrosion Inhibitor Packaging Utilizing Plastic Packaging Envelopes," U.S. Patent No. 5,517,945.
13. "Anti-corrosion Plastic Film Containing Recycled Resin," U.S. Patent No. 5,855,975.
14. B.A. Miksic, "Anti Corrosion Plastic Film Containing Recycled Resin," European Patent No. 0653454.
15. B.A. Miksic, et al., "Biodegradable Vapor Corrosion Inhibitor Products," U.S. Patent No. 6,028,160.
16. B.A. Miksic, et al., "Biodegradable Film," European Patent No. 00301117.8-2102.
17. B.A. Miksic, et al., "Corrosion Inhibiting Thermoplastic Alloys," U.S. Patent No. 6,054,512.
18. B.A. Miksic, et al., "Biodegradable Film," U.S. Patent No. 6,156,929.
19. "Vapor Phase Corrosion Inhibitor—Desiccant Material," Japanese Patent No. 3,121,489.

## Bibliography

- Australian Challenge, 103 Cheltenham, Victoria 3192 Australia 61 395 55 4944.  
 Cortec Corp., 4119 White Bear Parkway, St. Paul, MN 55110.  
 R.I.G. Packaging, 250 Rothesay Ave., Carnegie, PA 15106.  
 Weirton Steel Corp., 400 Three Springs Dr., Weirton, West Virginia 26062-4989.

*A version of this article was published in the May 1999 issue of Steel Times magazine. Published with permission.*

BORIS MIKSIC, FNACE is President of Cortec Corp., 4119 White Bear Pkwy., St. Paul, MN 55110. He has developed more than 300 products and systems that use VpCIs and volatile corrosion inhibitors. He has an M.E. from the University of Zagreb, is a NACE Fellow, and has been a NACE member for 26 years.

ROBERT W. KRAMER is a packaging consultant at Cortec Corp. He innovated the concept of stretch-wrapping tinplate coils on skids using VpCI stretch film. Throughout his 40-year career in paper and packaging he has been devoted to developing new ideas as a technician, sales representative, and manager of manufacturing and distribution. He has a B.S. in business administration from Ohio State University. *MP*

**Simple to apply**      **Removes rust easily**

**Mild on everything  
except Rust**

This biodegradable rust remover won't harm paint, plastic, wood, textiles or rubber. Just rust. Odorless and completely organic, you can use it just about anywhere: equipment, tools, locks, automotive, marine and farm equipment. Liquid or gel for indoor and outdoor applications. For complete facts call:

**CORTEC CORPORATION**      **1-651-429-1100**  
**www.cortecvci.com**

4119 White Bear Parkway, St. Paul, Minnesota 55110 USA  
 Toll Free: 1-800-4-CORTEC    Fax: 651/429-1122    Email: info@cortecvci.com

**VISIT US AT NACE EXPO 2001, BOOTH #601!**