PRODUCTS FROM SCRAP TIRES

A Presentation by

T. W. (Ted) Pattenden
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National Rubber Company Inc.

at the
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Thank you Eileen, and thanks as well to Brian James and The Rubber Association for the opportunity to talk to you today on the subject of "Products from Scrap Tires".

There appear to be two approaches to manufacturing so-called "value-added" products from scrap tires. (Slide 2) The first is to either use the tire directly and assemble it in some fashion, or cut it up into pieces, either to be used directly or assembled in some new form. This was, in fact, the genesis of National Rubber and we still produce some products by stamping parts out of tire side walls. These parts take advantage of the complex and durable composition of a tire, but tend to be lower value, small volume applications. In fact, we have tended to reduce our involvement in this type of product due to the large labour component and low customer perceived value. The applications for this type of scrap tire product are low volume niches that are unlikely to solve a significant portion of the scrap tire problem.

The second major approach has been to view scrap tires as a significant resource but not existing in a very useful form. This approach is
somewhat similar to the mineral processing approach. The scrap tires represent an "ore" which must be treated with a combination of physical and chemical processes to yield useful new materials. These new materials can then be processed into useful new products.

In the case of tires, the first step is to separate the components of rubber, fibre and steel. This is accomplished by grinding, followed by a combination of magnetic and density separation techniques. The "ore" is ground to whatever degree of fineness is required for subsequent processing.

The following slides show the plant we have built on the Port Lands in Toronto to accomplish the grinding and separation of tire components. I won't bore you with the details of why we chose this technology, except to say that a clean separation of all of the components was key to our decision.

Separation of rubber and fibre, as well as preservation of fibre length, is very important for National Rubber as both rubber and long fibre are key ingredients for our existing rubber products. National produces over 50 million pounds annually of rubber-based products. Many of these products have been traditionally manufactured from post-industrial tire plant scrap. This material, known as friction in the industry, is a mixture of uncured rubber and tire cord. The
use of fibre in tire rubber-based products yields three interesting and useful properties: * (Slide 3) 

- increased tensile strength
- increased tear strength
- increased stiffness

The problem that fibre creates is one of anisotropy, or lack of balance of properties and in some cases poor appearance. This is totally unimportant in largely three-dimensional products, such as dock bumpers, but can be very important in the production of thin gauge sheets. * (Slide 4) 

As much of the product that National Rubber makes is relatively thin gauge sheet, fibre is a necessary product for us to separate and retain its properties. Needless to say, unwanted steel in the fibre component could cause major problems.

While the use of tire fibre is possibly interesting, the main event is the rubber. How can this be transformed into useful products after primary grinding and separation? Many people have ground up tires, but failed to convert the rubber to a useful form in any significant volume.
Let me try to address this issue by showing you a generic picture of values versus properties. *(Slide 5)* This can apply to any recycled material when compared to its virgin counterpart. Clearly, if a recycled material had 100% of the properties of the original material, it would also have 100% of the value. If it costs more to recycle the material than its original counterpart, it will be a tough business to make any money in, but that is another story.

For our purposes, the maximum value from recycled tire rubber will be achieved when the properties of that rubber are as close to those of the original tire rubber possible. This is made extremely difficult because rubber is a thermoset polymer and cannot simply be remelted like plastics.

This set of circumstances gives rise to our slogan, "Recycling isn't garbage, it's science." *(Slide 6)* While National Rubber and many other producers make products such as mats, bumpers and even highly engineered products, such as recreational safety surfaces, these applications will not solve the major volumes of rubber available from our scrap tire "ore".

The following slide *(Slide 7)* shows typical properties achievable from vulcanizing a sheet from tire crumb and comparing its properties with sheets made from synthetic and natural rubbers. As you can see, the property recovery isn't
wonderful, but is adequate for matting and certain bulky items where compression forces predominate. Some people utilize chemical binders such as urethane to speed cures and improve final properties. However, if this is not managed very carefully, the cost addition outweighs the value derived and a business catastrophe results.

The approach we have taken at National Rubber (Slide 8) is to modify the properties of rubber obtained from tires in two ways:

- enhancement of properties with material from other polymer waste streams.
- regeneration of properties from the crumb itself

Both of these methods preserve the relatively low cost base possible when materials are derived from waste streams. The degree to which this approach will be successful (Slide 9) in growing the market for products made from scrap tires will be a function of:

- properties versus original materials
- processing ease in fabrication
- total part economics versus conventional technologies
An important feature of the overall economics is price stability over tire versus virgin rubbers and plastics.

When all of these factors are present, recycled materials will find a place in existing markets and products, and represent a viable and sustainable alternative to material destruction.

To give you an idea of where we currently are with the technology to make upgraded materials from scrap tires, this slide (Slide 10) shows you typical properties achievable with using both polymer modification and regeneration technologies. While we are not yet at the point of having virgin rubber properties from recycled tires, there has been significant progress in the laboratory and economically viable processes are being scaled up. As you will recall from a previous slide, the markets available for recycled materials will grow as the ability to recover the original product properties improves. We aren't ready for speed rated tires yet, unfortunately.

It is interesting to note that at the same time these new materials are being developed, there is a rapidly growing movement in North American industry to recycle their products. A major portion of our business is with the automotive industry and here we are seeing major new initiatives to use recycled and
recyclable materials in new cars. While we have active programs with each of the "Big 3" automotive producers, this excerpt (Slide 11) from a press release by Chrysler Corporation is the most public recognition of our activities to produce large volumes of parts from recycled scrap tires.

I know it is an impossible goal to see the entire North American scrap tire problem dealt with by the production of new parts and new end uses for rubber-based materials. I can see the majority of Ontario's problem being dealt with in this manner. Tires represent a very useful "ore" for parts fabrication (Slide 12) and, through the development of new and innovative technologies, we will see the recovery of much of the true value of the resource inherent in this major waste stream.

Thank you.

T. W. (Ted) Pattenden
President and CEO
National Rubber Company Inc.
PRODUCTS FROM SCRAP TIRES
# TWO APPROACHES TO PRODUCTS FROM SCRAP TIRES

<table>
<thead>
<tr>
<th>Approach</th>
<th>Methodology</th>
<th>Tire Utilization</th>
<th>Capability of Addressing Problem</th>
<th>Value Created</th>
</tr>
</thead>
<tbody>
<tr>
<td>Products directly</td>
<td>Utilization of parts of tire directly or via assembly</td>
<td>Low</td>
<td>Low</td>
<td>Low to moderate</td>
</tr>
<tr>
<td>Mineral processing</td>
<td>Grind/separate</td>
<td>Medium to high</td>
<td>Moderate to high</td>
<td>Moderate to high</td>
</tr>
</tbody>
</table>
PROPERTIES OF FIBRE/RUBBER MIXTURES

**Pluses**

- Increased tensile strength
- Increased tear strength
- Increased stiffness

**Minuses**

- Anisotropy
- Poor appearance
# Properties of Rubber/Fibre Blends are Not Balanced

<table>
<thead>
<tr>
<th></th>
<th>Rubber Only (Sidewall Compound)</th>
<th>Rubber/Fibre (30% Fibre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile (psi)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MD</td>
<td></td>
<td>800 - 1200</td>
</tr>
<tr>
<td>TD</td>
<td>2000 - 2200</td>
<td>500 - 800</td>
</tr>
<tr>
<td>Elongation (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MD</td>
<td></td>
<td>30 - 40</td>
</tr>
<tr>
<td>TD</td>
<td>500</td>
<td>50 - 125</td>
</tr>
<tr>
<td>Hardness</td>
<td>60 - 65</td>
<td>75 - 85</td>
</tr>
</tbody>
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VALUE CREATION IN RECYCLED MATERIALS

MATERIAL

FOR

RUBBER

Today

Potential For New Markets

Potential for Regenerated Rubber

Dynamic Parts

Industrial Tires

Existing Markets

PROPERTIES OF RUBBER

High Performance Tires

Mats
"Recycling isn't garbage; it's science."
# TYPICAL PROPERTIES OF RUBBER SHEET

<table>
<thead>
<tr>
<th></th>
<th>Revulcanized Crumb</th>
<th>SBR-Based Compound</th>
<th>Natural Rubber-Based Compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength (psi)</td>
<td>500</td>
<td>2000</td>
<td>3000</td>
</tr>
<tr>
<td>Elongation</td>
<td>150</td>
<td>580</td>
<td>550</td>
</tr>
</tbody>
</table>
More useful products can be made from waste tire material if:

1. The properties are enhanced by combining with polymers from other waste streams.

2. The properties of the original rubber can be regenerated from crumb.
Recycling of scrap tire rubber into new parts will be successful on a large scale when:

- Product properties meet or exceed those of products from current materials.

- Processing of recycled materials is easy.

- Total part economics are better than conventional processes.
NEW CRUMB-BASED MATERIALS

<table>
<thead>
<tr>
<th>Tensile Strength (psi)</th>
<th>SBR Rubber Gum</th>
<th>SBR Rubber Reinforced</th>
<th>Polymer Modified</th>
<th>Regenerated (non-reinforced)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1000</td>
<td>2000</td>
<td>800 - 1100</td>
<td>600 - 800</td>
</tr>
</tbody>
</table>
Chrysler to tackle scrap tire problem with recycling program

AUBURN HILLS, Mich. -- The problem of automotive tire disposal is one of the toughest landfill issues facing the nation. In an attempt to deal with the issue, Chrysler Corporation and National Rubber Company, Inc. have announced plans to make vehicle parts out of recycled tire rubber.

Parts initially targeted for production from the partnership will include steering shaft seals and fender liners. Chrysler is already using recycled rubber splash guards on its mid-size sedans.

National Rubber Company, of Canada, manufactured and sold about $6 million worth of rubber car parts to Chrysler in 1993. The companies also are researching the development of a high quality polymer grade recycled rubber for widespread use in auto parts.

February 15, 1994
"Recycling isn't garbage; it's science."