

---

## Product Safety Assessment

### **SARAN™ PVDC Resins and Films**

#### Select a Topic:

Names  
Product Overview  
Manufacture of Product  
Product Description  
Product Uses  
Exposure Potential  
Health Information  
Environmental Information  
Physical Hazard Information  
Regulatory Information  
Additional Information  
References

#### Names

- CAS Nos. 25038-72-6, 9011-06-7
- SARAN™ PVDC resins
- SARAN resins
- SARAN films
- Vinylidene chloride copolymer
- Vinylidene chloride / methyl acrylate copolymer
- Vinylidene chloride / vinyl chloride copolymer

#### Product Overview

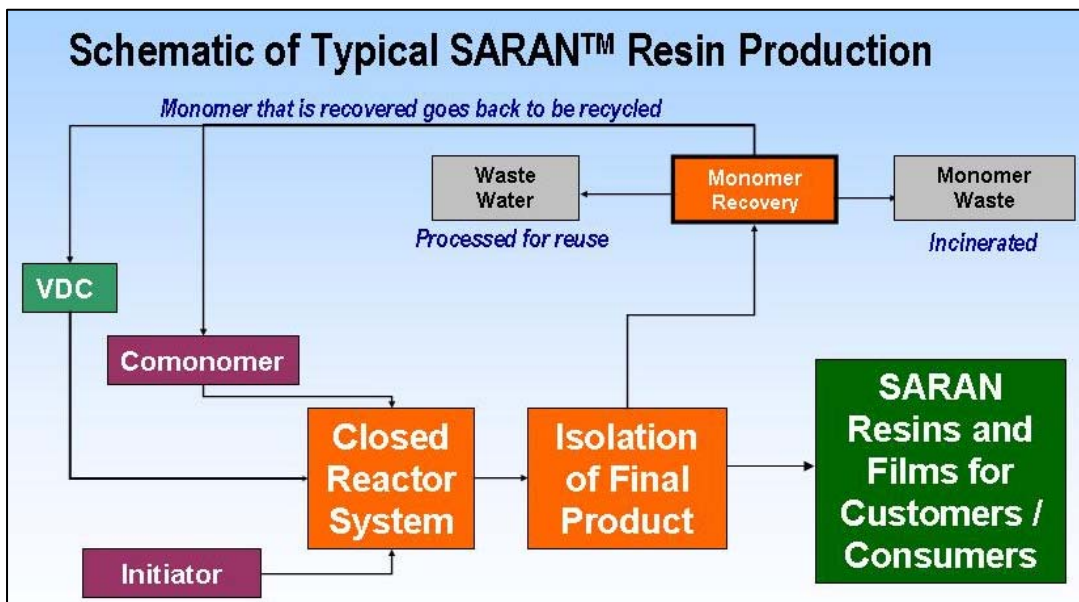
- Polyvinylidene chloride (PVDC) was among the first synthetic polymers to be commercialized. Low permeability to a wide range of gases and vapors is the most valuable performance property of PVDC-based polymers.<sup>1</sup> It makes them ideal for use in food packaging, consumer wraps and a variety of industrial applications that require excellent resistance to moisture and aggressive environments.<sup>2</sup> They help keep foods fresher for longer periods of time. Saran Wrap was manufactured from SARAN resins, but is not necessarily made from SARAN resins today. See Product Uses.
- The Dow Chemical Company ("Dow") has been a leader in PVDC production for over 60 years. Dow's longstanding trademark for PVDC-based polymers is SARAN™ resins and films. In industry, PVDC-based polymers are frequently called Saran. However, this does not mean that all PVDC resins are manufactured by Dow. See Product Description.
- Homopolymers are polymers made from only one type of monomer, or building block. Copolymers are polymers made from two or more monomers. PVDC homopolymers are difficult to fabricate, so only PVDC copolymers have commercial importance. Manufacturers of PVDC-based polymers often use additives to assist fabrication and performance.<sup>3</sup> See Product Description.
- SARAN resins, powders and films are considered safe for humans, wildlife and the environment. They are approved for food packaging by every regulatory agency in the world that sets food packaging regulations for polymers.<sup>4</sup> SARAN resins are white powders with little to no odor. The powder is essentially non-irritating to the skin, but the dust may cause irritation to the eyes, nose and throat. At high temperatures (> 392°F or 200°C), SARAN resins can decompose and generate hydrogen chloride (HCl) gas at concentrations which may cause respiratory irritation.<sup>5</sup> See Health Information.
- Because SARAN resins are used extensively in food packaging, it is possible for consumers to come into contact with them. Workplace exposure is also possible.<sup>6</sup> SARAN™ polymers are also sold as fabricated films. See Exposure Potential.
- SARAN resins and films also offer environmental advantages such as reducing waste and conserving energy.<sup>7</sup> See Environmental Information.

---

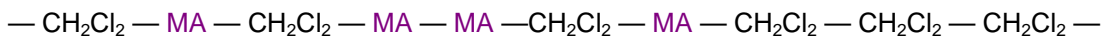
<sup>TM</sup> Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

## Manufacture of Product

- **Capacity** – Global consumption of PVDC-based polymers in 2004 was about 352 million pounds (160 metric tons).<sup>8</sup>
- **Process** – Vinylidene chloride (VDC) polymerizes using a variety of methods and processes. PVDC-based polymers are produced by reacting VDC with other comonomers like vinyl chloride (VC) and alkyl acrylates in closed systems under controlled conditions as shown in the process schematic below. An initiator is added to start the polymerization.



The location of comonomer units along the polymer chain depend on the quantity and reaction kinetics of the comonomer with VDC. The location and regularity of the comonomer units (shown in the schematic below) affect the properties and performance of the copolymer.<sup>9</sup>



## Product Description

Dow has been and continues to be a leader in PVDC production. Dow's longstanding trademark for PVDC-based polymers is SARAN™ resins and films. In industry, PVDC-based polymers are frequently called SARAN resins. However, this does not mean that all PVDC resins are manufactured by Dow. For example, Saran is sometimes used as a generic name for PVDC copolymers in the United States (U.S.), yet it is a Dow trademark in most other countries.<sup>10</sup>

PVDC homopolymer is difficult to fabricate, so only PVDC copolymers have commercial importance. Comonomers that are used with VDC to produce these copolymers are vinyl chloride and alkyl acrylates. Additives like plasticizers, stabilizers and extrusion aids are often added to PVDC-based polymers to improve performance during fabrication.<sup>11</sup> Note: phthalates are not used in SARAN resins or films. Uses of some phthalates have raised health concerns.

PVDC-based polymers can be produced using a variety of conditions, process types and comonomers. Additives can also vary widely and dictate the proper use of SARAN resins and films. For more information, please consult the SARAN™ Resins and Films Technical Center.

<sup>TM</sup> Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

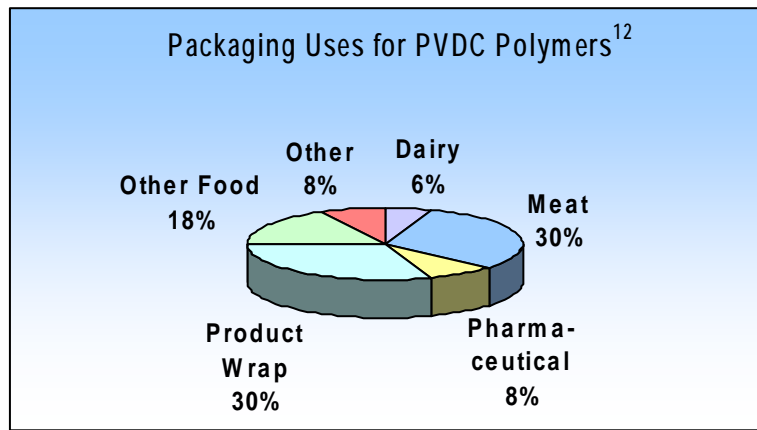
## Product Uses<sup>12,13,14</sup>

For over 60 years, SARAN™ resins and films have been used for barrier protection packaging.

- Food and pharmaceutical packaging
- Unit packaging for hygiene and cosmetic products
- Sterilized medical packaging

PVDC-based polymers can also be found in:

- Extrusion resins used to make filaments (fibers), films, rods, tubing and pipe
- Single or multi-layer films
- Multi-layer, rigid barrier containers
- Lacquer resins applied as coatings for food packaging, fuel tanks, and audio, video and computer tapes
- Latex coatings used in or on paint binders, flame-resistant carpet backing and bottle coatings
- Foams for composites used in furniture, marine applications and printing inks / paper manufacture



Saran Wrap was manufactured from SARAN resins, but is not necessarily made from SARAN resins today. For instance, Saran Wrap is not currently made from SARAN resins in the U.S. and Canada. However, Saran Wrap continues to be commercialized using SARAN™ resin in Europe.

## Exposure Potential<sup>15</sup>

SARAN resins and films are not sold directly to consumers, but are sold for use in consumer wraps and containers. Based on the uses for SARAN resins, the public could be exposed through:

- **Workplace exposure** – Exposure could occur in a manufacturing facility that makes SARAN resins or in a fabrication facility that uses SARAN resins. SARAN™ resins are produced in a closed system to minimize the risk of exposure to the monomers used to produce SARAN resins. The monomers that are used to produce PVDC polymers have health and handling hazards associated with them. PVDC itself is not harmful at room temperature. However, at temperatures greater than 392°F (200°C) or in fire situations, it can release toxic fumes, such as hydrogen chloride (HCl) that is produced from uncontrolled degradation. Each manufacturing or fabrication facility should have appropriate work processes and safety equipment policies in place to limit exposure to molten SARAN resin, resin decomposition products or the monomers used in manufacturing the resin. For information on exposure guidelines and protective equipment, see the Safety Data Sheet (SDS). For more information on health hazards, see Health Information.
- **Consumer exposure to products containing PVDC** – Although Dow does not sell SARAN resins for direct consumer use, consumers may come into contact with packaging and products that are made from them. Residual or unreacted quantities of monomers, including vinylidene chloride (VDC), in SARAN resins are analyzed and tightly controlled to maintain levels below regulatory limits. A risk assessment conducted for the Voluntary Children's Chemical Evaluation Program for the U.S. EPA considered potential exposures of children to VDC from its use in food wrap, among other sources of potential exposure. It was determined that there was an adequate margin of safety to protect children. The risk assessment was reviewed by a third party expert panel and is publicly available.<sup>16</sup> Because SARAN™ resins are used in food packaging applications, additives used in these materials are carefully selected for safety. Please review product labels and follow all instructions and guidelines for proper use to help prevent any unnecessary exposure. See Health Information.

<sup>TM</sup> Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

- **Environmental releases** – In the event of a spill, the spill should be contained to prevent contamination of soil, surface or ground water. If SARAN™ resins do enter surrounding waters or soil, they are not expected to be toxic. Spills of SARAN powder can create a slip hazard, and they should be cleaned up and disposed of properly. If SARAN resins are present in a fire situation or if they are heated to high temperatures (> 392°F or 200°C), they can produce toxic HCl fumes from decomposition. Proper protective equipment should be worn. See Environmental, Health and Physical Hazard Information.
- **Large release** – Industrial spills or releases are infrequent. Dow manufacturing facilities are designed to contain spills. If a large spill does occur, the material should be captured, collected and re-processed, or disposed of according to federal, state/provincial or local regulations. Because of the low toxicity of SARAN resins, no immediate health danger is expected. If the situation involves a fire, keep people away, isolate the area and deny unnecessary entry. Emergency personnel should wear proper protective equipment and follow emergency procedures carefully. When relevant in scale or risk, the community should be notified of the hazards associated with the specific release event. See Environmental, Health and Physical Hazard Information.

### **Health Information**<sup>17,18</sup>

SARAN resins and films are considered safe for humans, wildlife and the environment. They are approved for food packaging by every regulatory agency in the world that sets food packaging regulations for polymers.

SARAN™ resins are white powders that are essentially non-irritating to the skin, but the dust may cause irritation to the eyes, nose and throat. Repeated exposures to dusts of SARAN resins are not anticipated to result in systemic toxicity or permanent lung injury; however, excessive exposures may cause less severe respiratory effects. At high temperatures (> 392°F or 200°C), SARAN resins can decompose and generate HCl gas at concentrations which may cause respiratory irritation.

SARAN resins have residual monomers present at low levels. Monomers such as vinylidene chloride, vinyl chloride and methyl acrylate require health and handling precautions. Residual or unreacted quantities of these monomers in SARAN resins are analyzed and tightly controlled to maintain levels below regulatory limits.

- Vinyl chloride <200 parts per billion (ppb)
- Vinylidene chloride < 10 parts per million (ppm)
- Methyl acrylate < 5 ppm

Some SARAN™ resins also have additive levels up to six percent. Because SARAN resins are used in food packaging applications, additives are carefully selected based upon application and regulatory requirements to ensure consumer safety. Migration of substances from the polymer has been reviewed and found to be acceptable by competent technical reviewers within applicable government authorities. For a list of additives used in SARAN resins, see the Safety Data Sheet (SDS) for the product of interest.

SARAN PVDC films satisfy the requirements of established regulations for food packaging. Phthalates are not used in SARAN resins or films.

For more information on the health hazards of SARAN™ resins, their additives and recommended protective equipment, review the SDS.

### **Environmental Information**<sup>19,20</sup>

SARAN resins are polymeric solids and are not soluble in water. SARAN resins are not expected to be toxic in the environment. Spills that enter neighboring water sink to the bottom as

---

<sup>TM</sup> Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

sediments and may be dispersed by water movement. Spills on soil are expected to remain in the soil where they may be dispersed by the wind.

No bioconcentration is expected because of the relatively high molecular weight. Surface photodegradation may happen in sunlight. No appreciable biodegradation is expected.

Because SARAN™ resins are used in food and other packaging, waste management must be considered. SARAN resins can result in lower environmental impact throughout the packaging life cycle by:

- Reducing spoilage of packaged contents – which then produces less waste
- Enabling less packaging disposal to landfills – this is possible because SARAN resins provide the required protection with less film when compared to other plastics, meaning fewer or thinner layers of film and reduced amounts of packaging material
- Improving energy efficiency – because SARAN resins and films require lower temperatures (less energy) to produce effective packaging

When incinerated according to established industry standards, SARAN resins and films do not create harmful residues. In landfills, they do not contribute chemical contaminants to groundwater or emit HCl gas.

SARAN™ resins contain chlorine, a natural element found in many common items such as table salt in the form of a chloride ion. There has been concern among the public about chlorine. To put the chlorine content in perspective, consider a package of hot dogs. There is chlorine both inside the hot dogs (salt) and in the packaging material that contains SARAN resin (PVDC). Each hot dog, if not eaten and thrown away, contributes about the same amount of chlorine to the waste stream as the entire SARAN resin-coated package.

### **Physical Hazard Information<sup>21</sup>**

SARAN resins require fabrication at elevated temperatures (375-425° F or 190-218°C). Molten SARAN resin can cause burns to the skin. If contact with molten PVDC occurs, do not apply ice, but cool under ice water or a running stream of water. Do not attempt to remove the material from the skin. This could result in severe tissue damage.

If SARAN™ resins are heated to temperatures too high (> 392°F or 200°C), they can decompose and produce HCl gas. Decomposition can also occur at lower temperatures (> 347° or 175°C) over longer periods of time. Generation of gas during decomposition can cause pressure in closed systems. Pressure build-up can be rapid.

Do not expose molten SARAN resins to metals such as aluminum, magnesium, iron, copper and zinc. Processing in the presence of some of these materials can cause thermal degradation that releases HCl gas.

Hazardous decomposition products depend upon temperatures, air supply and the presence of other materials. Hazardous decomposition products include but are not limited to HCl. Polymer processing may release fumes which may include polymer fragments and other decomposition products. Fumes can be irritating.

Some guidelines establish a 5 ppm exposure ceiling to HCl. This level may be generated when SARAN resins thermally degrade. Review the guidelines established for your area and take the necessary precautions to ensure safe processing of PVDC. More detailed information about processing SARAN resins is available at the SARAN Resins and Films Technical Center (<http://plastics.dow.com/plastics/na/techcenters/saran/index.htm>).

---

<sup>TM</sup> Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

---

Do not permit dust to accumulate. Dust layers can be ignited by spontaneous combustion, hot surfaces or other ignition sources. When suspended in air, SARAN™ resin dust can pose an explosion hazard.

#### Fire Considerations

Under fire and high-temperature conditions, SARAN resin decomposes. The smoke may contain polymer fragments of varying compositions in addition to unidentified toxic and / or irritating compounds. Hazardous combustion products may include and are not limited to HCl, carbon monoxide and carbon dioxide. Dense smoke is emitted when burned. Fire fighters should wear positive-pressure, self-contained breathing apparatus (SCBA) and protective fire fighting clothing.

The fire area should be isolated and people kept away. Containers may rupture from gas generation in a fire situation. Soak containers and fire affected zone until fire is out and danger of re-ignition has passed.

If a rising sound from venting safety device or discoloration of the container occurs, withdraw all personnel from the fire area. Forceful application of fire extinguishing agents may cause a dust explosion hazard.

Additional physical property information for SARAN resin is available on the SDS.

#### **Regulatory Information**

Regulations may exist that govern the manufacture, sale, transportation, use and/or disposal of SARAN PVDC resins. These regulations may vary by city, state, country or geographic region. Information may be found by consulting the relevant SDS or Contact Us.

#### **Additional Information**

- Safety Data Sheet  
<http://www.dow.com/webapps/msds/msdssearch.asp>
- Dow's Plastics site  
<http://plastics.dow.com/plastics/>
- SARAN Resins and Films Technical Center  
<http://plastics.dow.com/plastics/na/techcenters/saran/index.htm>
- SARAN™ PVDC Resins & Films and the Environment, Dow Form. No. 190-00500-0305
- Vinylidene Chloride Monomer and Polymers: A Technical Report on VDC and PVDC  
[http://www.dow.com/PublishedLiterature/dh\\_0458/09002f1380458ac4.pdf?filepath=/PublishToInternet/InternetDOWCOM/plastics\\_ap/pdfs/noreg/190-00347,/PublishToInternet/InternetDOWCOM/plastics\\_eur/pdfs/noreg/190-00347,/PublishToInternet/InternetDOWCOM/plastics\\_](http://www.dow.com/PublishedLiterature/dh_0458/09002f1380458ac4.pdf?filepath=/PublishToInternet/InternetDOWCOM/plastics_ap/pdfs/noreg/190-00347,/PublishToInternet/InternetDOWCOM/plastics_eur/pdfs/noreg/190-00347,/PublishToInternet/InternetDOWCOM/plastics_)

For more business information about SARAN resins and films, visit Dow's Plastics site (<http://plastics.dow.com/plastics/>).

## References

- <sup>TM</sup> Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow  
Saran Wrap is a trademark of S. C. Johnson & Sons, Inc.
- <sup>1</sup> *Kirk-Othmer: Encyclopedia of Chemical Technology*, Fourth Edition, Vol. 24 (New York: John Wiley & Sons, Inc. 1997, "Vinylidene Chloride Monomer and Polymers," page 882.
- <sup>2</sup> [www.plastics.dow.com/plastics/about/saran](http://www.plastics.dow.com/plastics/about/saran)
- <sup>3</sup> *Kirk-Othmer: Encyclopedia of Chemical Technology*, Fourth Edition, Vol. 24 (New York: John Wiley & Sons, Inc. 1997, "Vinylidene Chloride Monomer and Polymers," page 882.
- <sup>4</sup> *SARAN™PVDC Resins & Films and the Environment*, Form No. 190-00500-0305, March 2005, pages 1-3.
- <sup>5</sup> *SARAN™506 Adhesive Polymer Safety Data Sheet*, No. 003484, February 4, 2003, page 1.
- <sup>6</sup> *SARAN™506 Adhesive Polymer Safety Data Sheet*, No. 003484, February 4, 2003, page 1.
- <sup>7</sup> *SARAN™PVDC Resins & Films and the Environment*, Form No. 190-00500-0305, March 2005, page 3.
- <sup>8</sup> *Barrier Films and Coatings – Market Projections, Technologies, and Economics for Flexible Barrier Packaging: 2004-2008*, Allied Development Corp., December 2004, [www.allied-dev.com](http://www.allied-dev.com).
- <sup>9</sup> *Kirk-Othmer: Encyclopedia of Chemical Technology*, Fourth Edition, Vol. 24 (New York: John Wiley & Sons, Inc. 1997, "Vinylidene Chloride Monomer and Polymers," pages 889-907.
- <sup>10</sup> *Barrier Films and Coatings – Market Projections, Technologies, and Economics for Flexible Barrier Packaging: 2004-2008*, Allied Development Corp., December 2004, [www.allied-dev.com](http://www.allied-dev.com).
- <sup>11</sup> *Kirk-Othmer: Encyclopedia of Chemical Technology*, Fourth Edition, Vol. 24 (New York: John Wiley & Sons, Inc. 1997, "Vinylidene Chloride Monomer and Polymers," page 882.
- <sup>12</sup> *Barrier Films and Coatings – Market Projections, Technologies, and Economics for Flexible Barrier Packaging: 2004-2008*, Allied Development Corp., December 2004, [www.allied-dev.com](http://www.allied-dev.com).
- <sup>13</sup> [www.plastics.dow.com/plastics/about/saran](http://www.plastics.dow.com/plastics/about/saran)
- <sup>14</sup> *SARAN™PVDC Resins & Films and the Environment*, Form No. 190-00500-0305, March 2005, page 1.
- <sup>15</sup> *SARAN™ 506 Adhesive Polymer Safety Data Sheet*, No. 003484, February 4, 2003.
- <sup>16</sup> The Dow Chemical Company, "Report of the Peer Consultation Meeting on Vinylidene Chloride," Voluntary Children's Chemical Evaluation Program (VCCEP), January 29-30, 2003, page 2.
- <sup>17</sup> *SARAN™ 506 Adhesive Polymer Safety Data Sheet*, No. 003484, February 4, 2003, page 1.
- <sup>18</sup> *SARAN™PVDC Resins & Films and the Environment*, Form No. 190-00500-0305, March 2005, pages 1-3.
- <sup>19</sup> *SARAN™ 506 Adhesive Polymer Safety Data Sheet*, No. 003484, February 4, 2003, page 5.
- <sup>20</sup> *SARAN™PVDC Resins & Films and the Environment*, Form No. 190-00500-0305, March 2005, pages 1-4.
- <sup>21</sup> *SARAN™ 168 Barrier Polymer Blend Safety Data Sheet*, No. 007040, February 5, 2003, pages 2, 4 and 5.

NOTICE: Although the information and recommendations in this document or at a related Internet Web site (hereinafter "Information") are presented in good faith and believed to be correct, The Dow Chemical Company and its consolidated subsidiaries ("Dow") makes no representations or warranties as to the completeness or accuracy of Information.

Information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability for their purposes prior to use. In no event will Dow be responsible for damages of any nature whatsoever resulting from the use of or reliance upon Information or the product to which Information refers.

Nothing contained herein is to be construed as a recommendation to use any product, process, equipment or formulation in conflict with any patent, and Dow makes no representation or warranty, express or implied, that the use thereof will not infringe any patent.

NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR THE PRODUCT TO WHICH INFORMATION REFERS.

Dow makes no commitment to update or correct any information that appears on the Internet or on its World-Wide Web server.

The information contained in this document is supplemental to the Internet Disclaimer <<http://www.dow.com/homepage/disclosure.html>> and is not intended to be all-inclusive as it relates to use, handling, storage, disposal and all other described activities. Recipients must make their own determination of suitability and are responsible for compliance with all applicable governmental regulations. This information is offered solely for your consideration and verification and in no event will Dow be responsible for damages of any nature whatsoever resulting from the use or reliance upon this information or the product to which this information pertains.

Form No. 233-00251-MM-1106

