PVC: WHAT DOES THE FUTURE HOLD?

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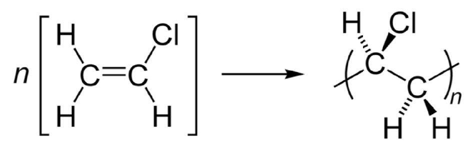
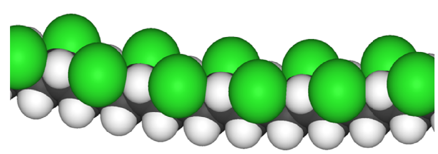
PVC is one of the oldest of the work horse polymers and has been in commercial existence since the early forties. PVC was a little known, brittle and hard to process, obscure material discovered by Regnault in 1835. It became a useful material only when Semon invented a method to plasticize PVC, thereby, making its processing feasible.

Henri Victor Regnault , 1835



On December 11, 1935, in Akron , Ohio Dr. Semon made flexible PVC by using a plasticizer, paving the way for its large scale applications

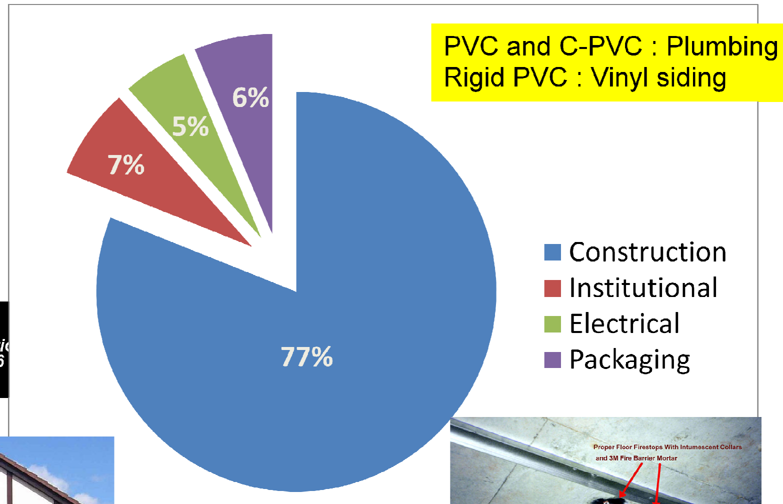
BFGoodrich Tires



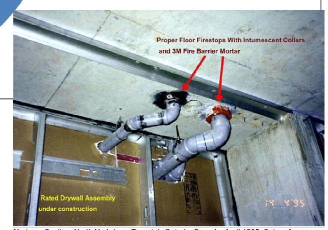
For many applications PVC is still the preferred polymer on account of a unique set of properties, namely, mechanical, barrier, electrical as well as intrinsic flame retardant properties and excellent outdoor weatherability. Therefore, it finds widespread applications in cable insulation, pipes and fixtures for effluent and water supply, irrigation pipes, building products (window profiles) as well as in sheets and films. In plasticized forms, PVC finds applications in a host of soft products (medical, upholstery, toys, beadings, bags etc.). PVC consumption is currently about 34 mta, slated to increase to 40 mta by 2016 with a per capita consumption of about 5 kg. Approximately 77% of PVC is consumed in construction related applications, the balance split equally amongst institutional, electrical and packaging applications.

[a] *summary of the key note lecture delivered at Vinyl India 2011, Mumbai on April 6, 2011*

Global consumption exceeds 34 million tons with a per capita consumption of 5.1 kg ; Consumpti will grow to 40 million tons by 2016



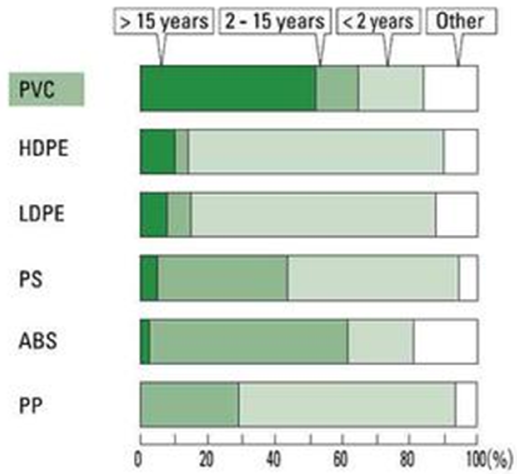
Applications : Global



Nortown Casitas, North York (now Toronto), Ontario, Canada, April 1995: Set-up for subsequent code infraction in plastic pipe wall penetrations: Improper hole sizing. Firestops (in the walls) the plumber considered to be the drywaller's responsibility. Floor openings are properly done in this case, with intumescent pipe collars and firestop mortar. The intumescent will expand and choke off the melting pipes. Drywall mud does not work as a plastic pipe firestop in the wall.

In India, the installed capacity for PVC is 1.3 mta, which is less than the consumption, namely, 1.9 mta. Thus, India is a net importer of PVC. There are over 1500 processors who process PVC in India. PVC consumption is growing at 10% per annum. To meet this demand India will need a 250 ktpa plant every year for the next few years! 70 % of India's PVC consumption goes in pipes, fittings and tubings with about 10 % each for films / sheets and wire / cable. The profile application in India is still in its infancy.

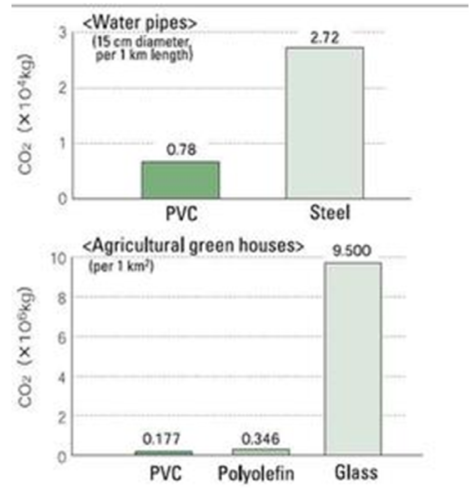
Recent debates on PVC have centered on whether PVC as a material is sustainable. PVC survives in its application for a period of 10-15 years. Consequently, it is eminently suited for use in long life cycle applications, making end-of-life issues less critical compared to poly (olefin) s and styrenics. Chlorine, extracted from sea water, constitutes a substantial portion of the weight of PVC. Hence its carbon foot print is low (low CO_2 emissions).



Source: Prepared from "A plastics demand structure survey report" by the MITI

Longest Life Cycle Applications

Low CO_2 emissions



Source: Prepared from the survey report by Chem Systems

VCM can be made from acetylene, an intermediate available from coal conversions. Hence, supply of the monomer is not fossil fuel dependent.

In spite of these advantages, PVC has been targeted aggressively by civil society groups. The main reasons cited are (a) hazards of VCM and dioxin formation from the process of oxy-chlorination of ethylene (b) plasticizer migration in flexible PVC (c) heavy metals in additives (d) problems associated with end of the use disposal ((incineration, landfill etc) and toxic emissions from fire.

In spite of significant efforts, there is no satisfying solution for the disposal of PVC at the end of its life. Mechanical recycling is often practiced but has significant problems due to excessive degradation of PVC upon reprocessing. Chemical recycling processes have been developed; however, they involve the use of solvents to dissolve and recover PVC. Other solutions such as replacing coke with waste PVC in coke ovens and gasification of PVC to hydrogen, carbon monoxide and HCl have been suggested. However, they have not been commercially used.

Obviously, use of PVC in short life time applications poses major problems. The intensity of the problem is somewhat less severe with long life time applications.

To put it in better perspective, one must realize that applications of PVC have evolved historically. Its current use reflects the fact that PVC preceded poly (olefin)s by quarter of century, making substitution in legacy markets difficult. However, in emerging markets there is a need to make rational decisions on the most appropriate materials for specific applications based on , both, "cost to consumer" and "cost to society" considerations. Blind imitation of products and its applications is not desirable merely based on consideration of historical growth of a material. PVC substitution must be seriously considered where appropriate.

So what lies ahead? Can our society survive without PVC? The answer is a resounding no. Is PVC sustainable? The answer is, if we restrict its use only to long life cycle applications and, even then, reprocess the material after its use. There is no case for use of PVC in short life time or flexible applications. In recent years alternative materials have emerged which must be used for such applications.

The process technology and product applications for PVC have attained a state of maturity that there are very little disruptive changes that can be anticipated. A variety of copolymers of vinyl chloride monomer are made commercially worldwide. The most important amongst these are copolymers with ethylene and vinylidene chloride. Chlorinated PVC (µ-PVC) is another material of commerce finding a wide range of applications in view of its superior thermal and flame retardant properties. Yet, there are many opportunities for incremental innovation in PVC. These are (a) replacing ethylene with ethane and, eventually, methane for the manufacture of VCM (b) efficiently recycling of HCl to chlorine (c) improvements in coal derived VCM process, such as, pyrolysis of coal in a thermal plasma reactor is under for the production of acetylene (d) mercury free catalyst for the conversion of acetylene to vinyl chloride (e) a gas phase process for the chlorination of PVC to produce µ-PVC as a replacement of the aqueous chlorination process which leads to the generation of waste streams (f) heat and water integration in the VCM and PVC plants (g) Integration of chlor-alkali plant with renewable energy source to minimize impact of energy cost on chlorine manufacture (h) replacing phthalate plasticizers with safer alternatives (i) eliminating heavy metals (lead/cadmium) in processing additives and (j) Improve thermal stability of PVC by eliminating structural defects in the polymer by careful control of polymerization process

Yet, the fact remains that as a mature and tested technology and based on inexpensive feed-stocks such as ethylene and chlorine, the economics of PVC as a material is unbeatable. Co-locating, PVC plant next to a cracker complex and chlor- alkali plant offers additional cost advantage in terms of utilization of surplus low cost chlorine available in such sites. Consequently, in spite of many concerns, PVC as a material is poised for a healthy growth, especially, in emerging economies which are seeing substantial growth in infrastructure (electricity generation and distribution, agriculture, low cost housing, water supply and sanitation etc). PVC is, therefore, here to stay.