

AFD Ep 403 Links and Notes - Vinyl (PVC) [Bill/Rachel] - Recording Dec 12, 2021

- Intro: Last week on the show we talked about bungalow houses taking off in the 1910s and 1920s, mostly due to new financial products to assist homebuyers. But we also discussed how falling materials costs and mass-production of parts helped reduce that cost to homebuyers and tended to make a lot of bungalow housing look very similar, apart from custom flair. This week we're jumping forward another half-century to look at a specific material that has greatly influenced the past 50 years of building construction: PVC. But to start, we need to go back in time first, to see its emergence out of the Second Industrial Revolution.
- [Rachel] PVC: Polyvinyl Chloride an 1870s invention that took off in the 20th century: https://en.wikipedia.org/wiki/Polyvinyl_chloride (Background: we already talked on our March 2021 [music industrialization episode](#) about vinyl records, the early mass application of PVC, and we also talked on our [transatlantic telegraph cable episode](#) in April 2021 about the challenges of installing durable undersea waterproof cables before plastic vinyl insulation)
 - <https://www.britannica.com/science/polyvinyl-chloride>
 - *The story peculiarly begins in two separate years—1838 and 1872—when French physicist Henri Victor Regnault and German chemist Eugen Baumann respectively discovered PVC for the first (and second) time. Neither followed up on the breakthrough, but on both occasions the polymer materialized as a “white solid” within flasks filled with vinyl chloride gas. Following these independent discoveries, no one actually mastered the use of PVC in commercial applications [Rachel: Because of its inert nature and rigid structure? Hard to combine with other chemicals?] until 1913, when a German inventor by the name of Friedrich Heinrich August Klatte decided to take out the first patent on the material. His polymerization method of vinyl chloride utilized sunlight, and over the next few decades companies around the world began experimenting where Klatte’s patent seemed to leave off.*
<https://www.piper-plastics.com/2017/03/27/a-brief-history-of-pvc/>
 - *In 1926, Waldo Semon, a scientist with the B.F. Goodrich Company in Akron, Ohio, found a practical use for PVC. The company directed Semon to find a way to bond rubber with metal. After trying numerous other substances, Semon tested PVC. After adding various substances to PVC, Semon succeeded in creating a flexible, water-proof, and fire-resistant plastic that could bond to metal as well as be formed into products by itself. Today, PVC is the second-most-used plastic in the world, with manufacturers producing nearly forty-four billion pounds per year. Retail sale of PVC earns producers a combined twenty billion dollars per year. More than fifty percent of PVC manufactured today is used in construction materials, especially pipes and window frames. Other uses for PVC include credit cards and vinyl records.* https://ohiohistorycentral.org/w/Polyvinyl_Chloride
 - *Around the early 20th century, B.F. Goodrich hired industrial scientist Waldo Semon to develop a novel, synthetic alternative for the increasingly expensive natural rubber. [NEED TO MENTION OUR APRIL 2021 EPISODE ON RUBBER/SYNTHETICS HERE] Polyvinyl chloride experiments were started, but the project was soon threatened by the recession of 1920. That’s when Semon had an incredible idea: using PVC as a water-resistant coating for fabrics. Soon enough, sales of the material rapidly took off, with demand peaking at the start of World War II, when PVC was adopted as an insulator for wiring on military ships.* <https://www.piper-plastics.com/2017/03/27/a-brief-history-of-pvc/>
 - Plasticizers were first used with PVC by B.F. Goodrich in 1930. Plasticizers, when processed with PVC, create a flexible polymer. The more plasticizer added to the

PVC, the lower the temperature that PVC can maintain flexibility. These technological breakthroughs unlocked the usefulness of PVC, and helped PVC become the material powerhouse it is today, a durable material able to withstand a wide range of temperatures without degradation. Today, almost 90% of plasticizers used go into PVC production.

<https://www.traquisa.com/en/informacion/plasticizers/>

<https://en.wikipedia.org/wiki/Plasticizer>

- [Bill] *in 1930 the Union Carbide Corporation introduced the trademarked polymer Vinylite, a copolymer of vinyl chloride and vinyl acetate that became the standard material of long-playing phonograph records.*
<https://www.britannica.com/topic/industrial-polymers-468698/Polyvinyl-chloride-PVC#ref608644>
- Unsurprisingly given their natural resource constraints especially in the post-WW1 era and then the WW2 sanctions era, Germany was especially interested in expanding the use of synthetic materials like PVC, which remember had finally been patented in Germany shortly before WW1: *By 1932, the first tubes made from a PVC copolymer were produced. Nearly three years later the first PVC pipes were produced using a roll mill and hydraulic extruder. This two-step process involved melting the PVC powder on a roll mill and rolling the sheet produced up to a billet. The PVC could then be processed in a discontinuously working ram extruder to make pipe. This process was adapted from that used for celluloid and was really ill-fitted for PVC. As a result, the products were often of dubious quality. Nevertheless, these early PVC pipes were deemed suitable for drinking water supply piping and waste water piping because of their chemical resistance, lack of taste or odor and smooth interior surface. From 1936 to 1939 over 400 residences were installed with PVC drinking water and waste pipelines in central Germany. Various test pipelines of PVC were laid in Leipzig, Dresden, Magdeburg, Berlin, Hamburg, Cologne, Heidelberg and Wiesbaden during the period of 1936 to 1941. Both the pipelines for chemicals and those for water supply and waste water came up to expectations, as did the test pipelines in the cities mentioned above, apart from damage caused by World War II. The PVC pipes installed in central Germany are still in use today without any major problems.*
<https://www.jmeagle.com/early-history-pvc-pipe>
- The US began deploying PVC pipes in 1952. They're now a major part of sewer and water infrastructure:
https://www.sewerhistory.org/articles/compon/pdfs/pvc_water_milestones.pdf
- Here's the quick official history page on PVC from the producers' lobbyist organization in the US, the Vinyl Institute: <https://www.vinylinfo.org/history/> The lobby claims to represent a "U.S. vinyl industry [that] encompasses nearly 3,000 vinyl manufacturing facilities, more than 350,000 employees and an overall economic value of \$54B."
- [Bill] Vinyl siding and other home construction uses:
 - https://en.wikipedia.org/wiki/Vinyl_siding - a very distinctive look (starting slowly in the 1950s but especially taking off since the 1970s) for housing in the US and Canada. Acts as a substitute for wood clapboard or aluminum siding, the latter being most closely emulated visually. Since the 1970s it has been more colorful and more resistant to ultraviolet fading. The industry also consolidated significantly in the 1970s with the arrival of new production methods required by stronger workplace protections for PVC factory workers who were developing rare cancer. It's supposedly relatively hard to make vinyl siding on houses catch

on fire, which is an important consideration in densely packed housing tracts and with growing wildfire seasons, but once on fire PVC is quite hazardous due to its toxins.

- *By the 1950s, PVC production was soaring around the world. Five companies in particular started testing out revolutionary uses for 'vinyl' PVC, finding new applications for the material in inflatable structures and fabric coatings. The construction industry soon welcomed the durable plastic, in large part due to its resistance to light, chemicals and corrosion, which made it a prime commodity for building structures. Further improvements were made to PVC's temperature resistance in the 1980s. It's around this same time that thousands of American homes began incorporating the material into plumbing systems...*
<https://www.piper-plastics.com/2017/03/27/a-brief-history-of-pvc/>
- *Pure PVC finds application in the construction trades, where its rigidity and low flammability are useful in pipe, conduit, siding, window frames, and door frames. In combination with plasticizer (sometimes in concentrations as high as 50 percent), it is familiar to consumers as floor tile, garden hose, imitation leather upholstery, and shower curtains.*
<https://www.britannica.com/topic/industrial-polymers-468698/Polyvinyl-chloride-PVC#ref608644>
- [Rachel] https://en.wikipedia.org/wiki/Sheet_vinyl_flooring
 - Sheet vinyl flooring comes in large, continuous, flexible sheets. This makes it impermeable to water, unlike vinyl tile or vinyl planks that interlock. This makes it an attractive option for kitchens, bathrooms, and house entryways where people track in water. It's also highly durable, easy to install and relatively inexpensive.
 - Sheet vinyl is often digitally printed to have skeuomorphic designs mimicking other, non-plastic surfaces like wood flooring.
 - Pretty toxic and not a good time if they catch on fire, or even just before they're about to catch on fire...
 - Another disadvantage is it's not commonly recycled, and most sheet vinyl ends up in the landfill at the end of its use. Landfilled vinyl releases VOCs such as phthalates that can leach into the ground. Phthalates are used to make PVC softer and flexible.
 - A successor to Linoleum, which was itself invented (between 1855 and 1864 in England) during an unsuccessful attempt on a different track to synthetically replace natural rubber: <https://en.wikipedia.org/wiki/Linoleum> Linoleum was immensely popular from about the 1860s to about the middle of the 20th century. Linoleum makers today would argue that they are still the all-natural, eco-friendly, and biodegradable alternative to polyvinyl chloride flooring.