Super pipe

by David A. Chasis

Conventional PVC pipe has been successfully installed for over three-quarters of a century and has become the most abundant piping system on the planet. Why? It is durable, easy and safe to install, cost effective and environmentally sound. So how can you improve upon a product that for so long has had market share in dozens of applications? The answer is bi-axially molecularly oriented PVC pipe (PVCO).

Overview of PVCO

When conventional PVC pipe is extruded, it is made by a fully automated one-step continuous extrusion process that results in the final product having its vinyl polymer chains oriented randomly. PVCO pipe undergoes a controlled stretching process after extrusion which alters the pipe material by orienting polymer chains in a specific and ordered fashion.

Molecularly oriented pipe is not a new concept. The method for manufacturing PVCO was developed in the mid-1970s in Europe and was comprised of a two-step or "batch" process. Conventional PVC pipe was extruded, and then each pipe length was expanded under controlled temperature and pressure in a large mold. While this process was effective, it was difficult to control and automate.

Most PVCO pipe is now made using a continuous process by stretching a thick "feed stock" PVC profile over a precisely sized mandrel under tightly controlled temperatures and pressures. This process results in creating PVC pipe with its polymer chains orientated in two directions, instead of randomly — in both a circumferential and longitudinal direction — hence the industry's label of "bi-axial oriented" pipe.

Improvements to the original orientation process have been made by European developers in the '90s who have met the challenge of producing a quality and price competitive PVCO piping product using an automatic in-line process. An important side benefit of this automated process, besides lower production costs, is that PVCO pipe is available with closely controlled external and internal pipe diameters making pipe wall tolerances much tighter than conventional PVC.

In-line process for manufacturing PVCO pipe.

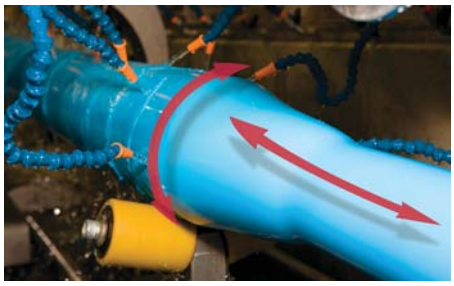
Improved features and benefits

OK, so why the excitement over molecularly oriented pipe? The answer is that PVCO pipe maintains the many qualities of conventional PVC pipe such as excellent chemical resistance, non-corrosive, ease of installation, durability, low thermal conductivity, smooth flow, fully recyclable, low or no maintenance requirements, code compliant, resistant to water permeation and cost effective while having several major product improvements. These improved features are:

- *Hoop strength:* PVCO pipe has almost double the hydrostatic design basis (HDB) of PVC (7,100 psi versus 4,000 psi). HDB is used with a given service factor to calculate hydrostatic design stress (HDS). HDS is used as the basis of calculating various pipe pressure ratings. Greater hoop strength allows thinner-walled pipe, larger internal diameters and reduced transport energy costs compared to similar diameter and pressure-rated PVC piping.
- *Lightweight:* PVC pipe is lighter in weight than most piping materials. However, most PVCO pipe is on average 40 percent lighter than PVC. The lighter weight results in an easier to install and less expensive pipe installation. For example, one man can easily carry a 20-foot length of 10-inch PVCO pipe.
- *Impact resistance:* The impact strength of PVCO pipe is 3-5 times that of PVC. This feature results in a much tougher and resilient product that can withstand more field site abusive conditions than many other piping systems even at temperatures as low as 32°F (0°C).
- *Resists cracking:* PVCO's pipe wall is composed of stratified material versus a single layer pipe wall in PVC. This unique feature increases notch resistance, thereby minimizing splitting and crack propagation. This characteristic also adds to the safety and ease of tapping into pipe walls in underground applications and bodes well for possibly future grooved-piping aboveground uses.
- *Flexible:* Like impact resistance, pipe flexibility is an extremely important characteristic for heavily trafficked areas. PVCO pipe is extremely flexible and practically crush-proof. And, having lower bend radii than PVC pipe, PVCO piping use may mean fewer fittings are required.
- *Cyclic fatigue resistance:* Force main and irrigation piping systems normally are subjected to many cycles of flow throughout their use. With much higher hoop stress capability than conventional PVC, PVCO is an excellent choice for increasing the piping life of cyclic applications over other competing piping materials.
- *Water hammer:* The lower pressure-wave velocities of PVCO piping compared to other piping systems reduces or eliminates the possibility of pipe damage due to excessive surge pressure or water hammer.

Man carrying a 20-foot length of 10-inch PVCO pipe.

Tapping PVCO pipe is quicker and stronger than PVC pipe.



Orienting PVC piping axially and circumferentially.

• *Environmentally sound:* Due to PVCO pipe's thinner wall and reduction in pipe weight, there is much less embodied energy in PVCO than other piping materials. Plus, the thinner walled pipe increases the inner pipe diameter to optimize fluid flow while reducing the amount of energy to transport fluids.

Considerations

Are there limitations for PVCO piping systems? Yes! Presently, almost all PVCO applications are used for underground pressurized systems such as water mains, sewer force mains irrigation systems and industrial lines. Pipe diameters are limited from 4-inch to 16-inch in cast iron and iron pipe dimensions. The typical joining method used with PVCO piping is gasketed-bell. While research has shown that solvent cementing can be used to join PVCO pipe, it is currently not supported in existing AWWA and ASTM standards. It is very likely that on-going research will shortly produce a reliable and certified solvent cemented pipe joining system for PVCO. One other concern to note is the process of making molecularly oriented pipe *prevents* heat fusion techniques to be used in joining pipe or fabricating fittings.

PVCO pipe will flex but not break.

In the future, except for drain, waste and vent and other low-pressure applications where excessively thin pipe walls could present problems (especially in aboveground installations), PVCO will become more and more prevalent. The most likely expansion of PVCO pipe in the near future will be in AWWA water main applications where pipe process technology may soon be able to increase the pipe diameter offerings to 24-inch or higher from the present 16-inch maximum. And, once a compatible solvent cementing system is developed and proven, many aboveground commercial and industrial applications will be available for PVCO piping installations.

Summary

There has not been a more significant development in the North American piping industry in the last 10 years than the advent of biaxially oriented PVC. Whether one considers quality, installed costs or an environmentally light footprint, no other piping system can quite compare to super pipe — PVCO. ■

Toughness of PVCO pipe to withstand crushing.

Photos courtesy of IPEX Inc. The author would also like to recognize the very helpful input and comments from associates of IPEX Inc., JM Eagle and Wavin Overseas B.V.

David A. Chasis is president of Chasis Consulting, Inc., author of the book "Plastic Piping Systems," and a member of and consultant to the Plastic Pipe and Fittings Association. Chasis can be reached at Chasis Consulting, Inc., 329 The Hills Drive, Austin, TX 78738 USA; (512) 261-9115, fax (512) 261-3518, e-mail: dchasis@austin.rr.com, www.davidchasis.com.