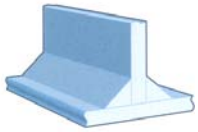
WEGENER WELDING
THE PLASTIC WELDING EXPERTS

16W301 S Frontage Rd
Burr Ridge, IL 60527
Phone 630-789-0990
FAX 630-789-1380
www.wegenerwelding.com

JANUARY, 2003

HOT GAS EXTRUSION WELDING – AN EXPANDING TECHNOLOGY

With the expanding applications of industrial thermoplastics, so is the application of the hot gas (air) extrusion welding technology. Most plastic welding facilities today own one or more of these welders to optimize their welding efficiency. Originally invented to replace multiple pass hand welds in tank construction, the process today can be found in numerous applications and industries, some of which would not exist without this technology. Some examples include the linings of landfills or ponds, concrete protection systems, UHMWPE liners or HDPE manholes and piping applications, just to name a few. The most common materials extrusion welded are PP and PE with some fabricators expanding into PVC, PVDF and recently as well CPVC.


Extrusion weld


Multiple pass hand welds

The name is derived from the extrusion process with the majority of models based on screw extrusion technology. Some smaller machines utilize either injection or ram extrusion principles.

The typical extrusion welder is equipped with a screw inside an extrusion chamber and a rod intake, which pulls in standard round welding rod from a spool. The most common drive is a universal motor, while some manufacturers now offer DC or hydraulically driven units. The rod is purged through various zones inside the electronically heat controlled chamber and the machine expels a fully molten strand which is applied into the weld zone. The diameter of the welding rod depends on the size and type of machine. Hopper (pellet) fed machines are available but are rarely used due to contamination and gravity feed problems.

In order for a molecular bond to take place, a preheater is mounted next to the machine to produce a hot air stream into the weld area just prior to the strand (extrudate) being applied. Of great importance for the quality of the weld is that the air be clean, oil and moisture free and adjusted in temperature and volume to produce a sufficient parent material melt. The market knows self contained machines which have a preheater generating its own air as well as standard units which are connected to an external, higher

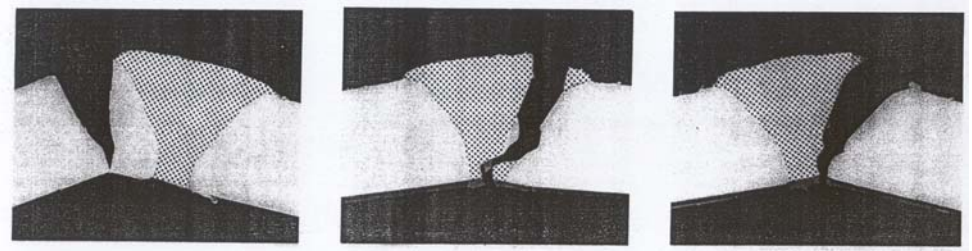
WEGENER WELDING
THE PLASTIC WELDING EXPERTS

16W301 S Frontage Rd
Burr Ridge, IL 60527
Phone 630-789-0990
FAX 630-789-1380
www.wegenerwelding.com

volume air source. When using the self contained machines specific care needs to be taken to assure that the parent material is sufficiently heated.

Of great importance is the welding shoe located at the very front where the extrudate emerges. The shoe serves as a die determining the size and the geometry of the weld. It is made of PTFE, which is easily machined and, due to its low coefficient of friction, provides for a smooth weld appearance. The speed of an extrusion weld is directly related to the size of the weld compared to machine output capacity. Similar to hot gas (air) hand welding, the extrusion weld requires a prepared V-groove to create a full penetration weld. Depending on sheet thickness, the angle of the V should be between 45º and 90º. A V-groove is not used when welding thin gauge materials in the range of .020" to .100" where an overlap weld is preferred.

Air outlet, teflon shoe for T-joint welding and emerging PP extrudate



Fracture behavior at different welding speeds with all other factors remaining the same

Extrusion welding personnel should be adequately trained as the process incorporates a number of parameters and their correlation. Setting up the equipment, selecting or designing the correct welding shoe configuration, making the proper temperature adjustments in correlation to speed and shoe design and executing a good weld require process knowledge and practice. Regretfully, no US standards or guidelines have yet been established for this process as it relates to materials other than geomembrane linings. At this time most companies use the relevant DVS (German Welding Society) guidelines. Through the AWS (American Welding Society), efforts are under way to establish corresponding US documentation.

Automating the process can be beneficial depending on size, configuration and amount of parts or structures to be welded. For the fabrication of tanks, robots have been adapted to rout a V-groove, extrude a weld and afterwards mechanically finish the weld for best cosmetic appearance. All the operator has to do is to remove the finished structure, set up and clamp new sheets in place and start the robot. Below is a picture of an automatic machine, which performs a weld to close off the space between a fabricated double wall cylinder.

16W301 S Frontage Rd
Burr Ridge, IL 60527
Phone 630-789-0990
FAX 630-789-1380
www.wegenerwelding.com

Automated extrusion welder

Since automated systems are rare, the majority of extrusion welding is performed manually. Manufacturers are continually working to develop machines providing the best weight, size and output ratio to facilitate the task of the operators. The challenge is to build smaller, more compact machines while not sacrificing durability and quality of the extrusion process with the various materials.

A book on hot gas (air) extrusion welding and other thermoplastic welding topics was published by Hanser Publications in April 2003, ‘Plastics and Composites Welding Handbook’, authors D. Grewell, A. Benatar and J.B. Park.