

## **TOPIC: Welding Temperatures and Smart Welders**

Each month Tim Stark introduces a new technical topic for discussion and possible action. This month's topic is: "**Welding Temperatures and Smart Welders**". This topic generated significant discussion with the main "take-aways" listed below. **However, this discussion mainly focused on HDPE geomembranes so the recommendations below should not be automatically applied to other geomembrane polymers, such as, PVC, CSPE, Polypropylene, PVC-EIA, etc.**

### **Welding Temperatures**

- Main welding research question is how hot is too hot for geomembrane welding? See below but 850F now appears to be too hot
- Welding window is wide for HDPE geomembranes so a range of temperatures can result in passing seam tests so have to prevent overheating
- Big concern is overheating an HDPE geomembrane can result in stress cracking – Queens University research
- Heat affected zones in seams causes a loss in antioxidants, which increases potential for stress cracking
- May have to reduce maximum weld temperature but then have to reduce welder speed
- Need to find a temperature that does not damage the geomembrane
- Maybe hotter is better because seam pass but higher temperature reduces long-term performance – for example, 850F v. 750F v 650F depending on ambient temperature yield same seam test results but 850F reduces antioxidants and increases stress cracking
- New welders are now being set at 750F instead of 850F
- IAGI Geo-Games will use a maximum temperature of 750F next year
- **Recommendation is use 750F and a certain pressure; if ambient conditions change adjust welder speed not temperature or pressure so not varying multiple parameters at the same time**
- Welder speed is a function of ambient conditions – for example high sheet temperature can impact welding temperature and must weld at night when it is cooler
- A good technician is the best solution to welding problems – their goal is NOT to have a failing seam test
- Australians seeing cracking outside of the seam -
- Essentially flash heating the geomembrane by the welder to create a seam, which is a concern
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### **Best Welding Practices**

- **Recommendation is use 750F and a certain pressure; if ambient conditions change adjust welder speed not temperature or pressure so not varying multiple parameters at the same time**
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## **Smart Welders**

- Smart welders record pressure, temperature, and speed but still need qualified welders
- All data is GPS located, time stamped, and transmitted via WiFi.
- Uses of smart welders include:
  - Improve seam quality because real-time data on seams
  - Can troubleshoot seams
  - Can quantify efficiency of each welder on the site
  - Can help determine if weld temperature is too hot for the geomembrane by comparing weld temperature with destructive seam test results –  
GOOD RESEARCH TOPIC
    - Data is useful for solving welding problems in the field
    - Can identify which machine is encountering more problems and anomalies than other welding machines
- Training is available for using smart welders
- Seam test results are decreasing with time and research is trying to relate to weld temperature to long-term seam test results
- If destructive samples are passing, welder can record the parameters that yielded the passing test and for long-term evaluation of the seam
- Is there any correlation between immediate seam test failures and anomaly in smart welder data? Yes and can identify area where a welding anomaly occurred during seam welding, such as, a decrease in temperature or increase in speed, to isolate location of failed seam quicker.
- Another example is a technician accidentally bumps the seam speed dial but doesn't notice it; however, reviewing data remotely, the technician can be alerted to the change/increase in speed
- Still need field CQA because dirt, improper seam overlap, or duct tape in seam area will not be identified by the smart welders
- Artificial Intelligence (AI) can be used with the data to identify potential problem areas
- Installers can evaluate various welding teams by comparing data between welding teams
- Data recording has been used in Germany for over 40 years – can't move to next cell until engineer approves prior welds based on smart welder data but Germany uses 100 mil thick instead of 60 mil thick in USA
- Germany sets maximum weld temp at 720F, which is less than 850F and now 750F, to protect geomembrane integrity
- Need education to increase use of smart welders and for engineers to specify use of smart welders
- New large floating cover project in California requires smart welder be used for both factory and field welds
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