Trial report 27th March 2001

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Executive summary

Evaluation tests have been carried out on the UltraSense™ cable extrusion monitor. The system uses ultrasonic signals to inspect the internal geometry and quality of polymeric HV and EHV cables as they are extruded.

The monitor's layer thickness measurement was shown to be as accurate as the laboratory measurements and inclusions as small as 200µm were successfully detected near the inner screen of a 132kV cable. These results show that the UltraSense system can provide very high resolution quality assurance monitoring.

Layer thickness in 132kV Cable

A length of 185mm^2, 132kV cable was inspected using the UltraSense machine. It was approximately 600m long and thought to possibly have problems at the inner screen.

The cable was run through the unit at approximately 1m/min. The data from the inspection was taken on CD for analysis.

The line on which the cable was run was prone to periodic changes in cable tension, this, in combination with the fact that the system was raising the cable above its natural height in the line, gave rise to considerable movement of the cable within the monitor. This meant that the cable was not always central within the inspection annulus but moved up and down.

Figure 1 shows the inner screen thickness as measured by two opposite transducers. Measurements are based on the absolute distance between the transducer and the interfaces on either side of the screen. The cable movement makes it impossible to see problems in the screen. Figure 2 shows the highlighted part of figure 1, and figure 3 the highlighted part of figure 2.

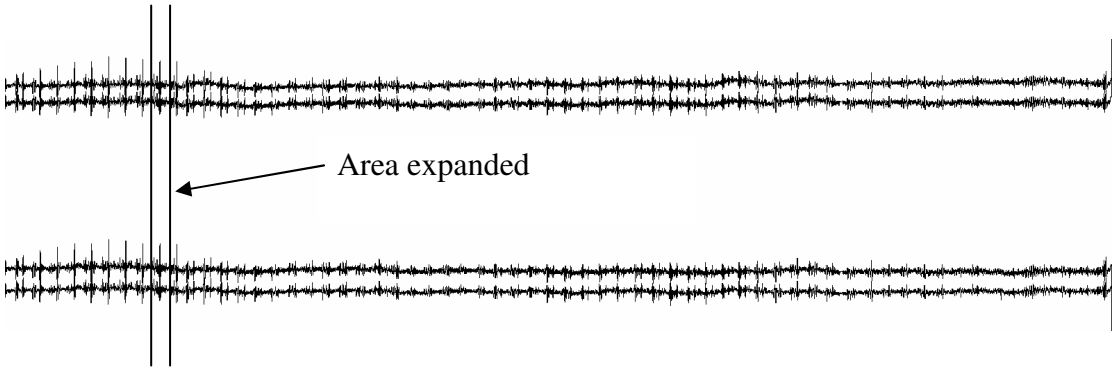

Figure 1: Inner screens over full 600m cable length.

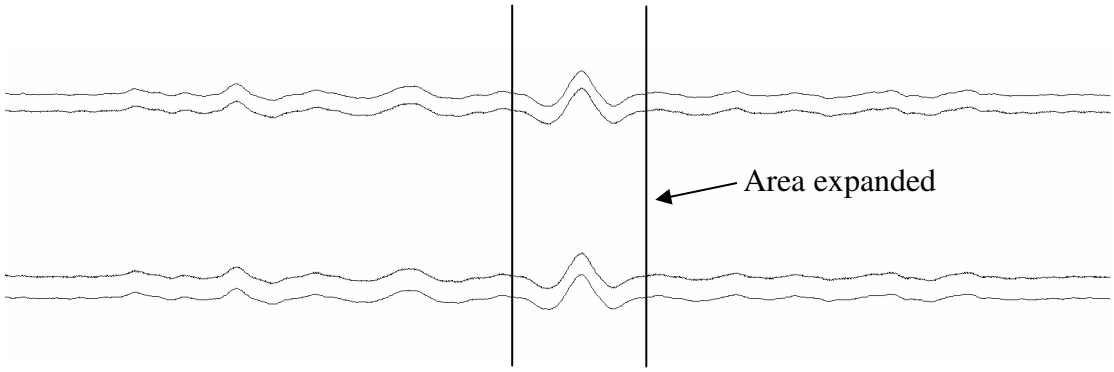

Figure 2: Inner screen over approximately 12m length of cable.

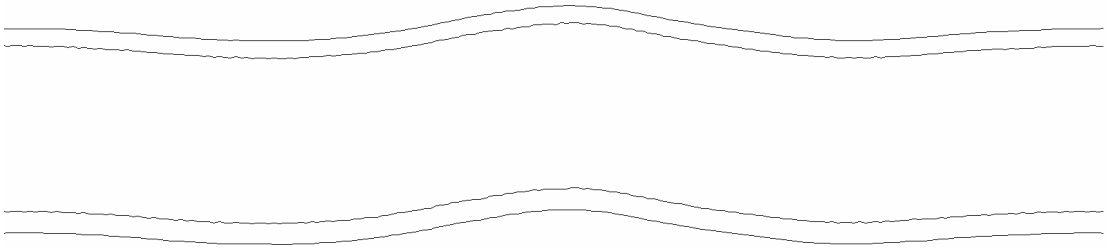

Figure 3: Inner screen over approximately 1.5m length of cable.

As there were approximately 120,000 readings per transducer, it was very difficult to graph the data for inspection using a standard spreadsheet. A programme was therefore written to process the data to eliminate the effect of the movement of the cable.

As it would not be accurate to take any single one of the interface positions as an absolute reference for the others to be measured from, it was decided to use the position of all eight interfaces measured by any two opposite transducers to calculate a correction factor.

Figure 4 shows a typical section of the inner screen over the full length of the cable once rationalised in this way. Figure 5 shows the inner screen over approximately 12m.

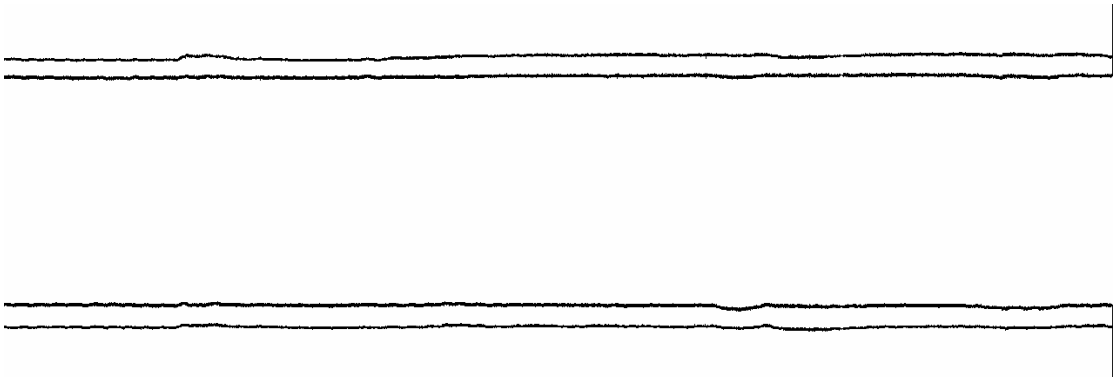

Figure 4: Inner screen over full cable length.

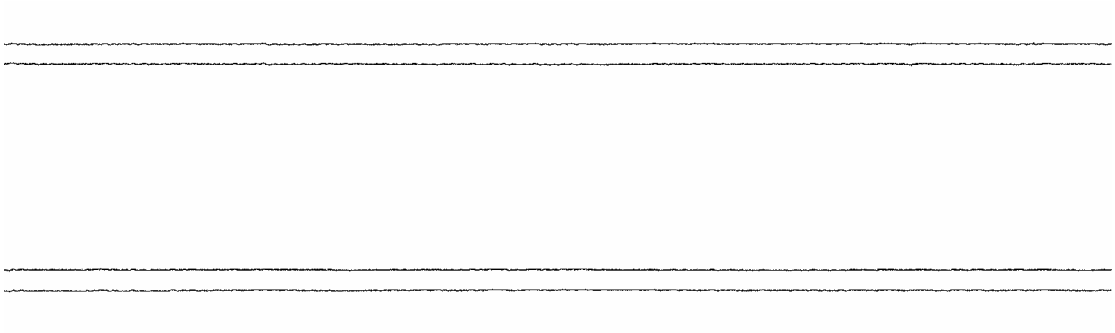

Figure 5: Inner screen over approximately 12m.

The inner screen as measured by all transducers was analysed in a similar way. There was variation, up to approximately 20%, in the thickness of the inner screen measured over the full cable length. There were no points however where the screen appeared to have manufacturing defects.

Conclusion

The UltraSense system measures the layer thickness of all three screens with a degree of accuracy comparable to the experimental error involved in laboratory measurements. Inner screen thicknesses need to be regarded in the context of the measuring technique, for both ultrasonic and laboratory measurements.