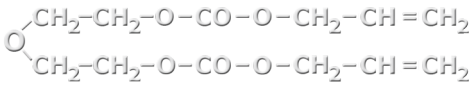
TASTRAK performance sheet

Alpha-particles

General description

Main composition: Polyallyl diglycol carbonate (PADC):



- Appearance: Clear, colourless, rigid plastic
- Density: 1.30 g.cm^{-3}
- Thicknesses: 0.75, 1.0 and 1.5 mm
- Specialist thicknesses: 100 - 200 µm and 500 µm
- Tested for background and α-particle response

Mode of action

When an α-particle enters the TASTRAK plastic track detector, it creates a trail of damage along its path. This damage is invisible but may be revealed by chemical etching. Figure 1 shows the typical evolution of etch track when the detector is immersed in 6.25 M NaOH at 98°. The bulk plastic is etched at a characteristic bulk etching rate, V_b but preferential etching takes place along the axis of the particle track at a characteristic track etching rate V_t. Each horizontal profile represents the vertical section of the post-etch surface across the track at a given etch time.

Figure 2 shows a microscope view of a typical α-particle etch track for two quite different etch times in 6.25 M NaOH at 98°C. The tracks on the right were etched for 1 h and display the characteristic cone-like structure. Continued etching results in larger tracks but track structure is progressively lost. The track on the left was etched for 5 h.

In practice, α-particles enter the detector at a variety of angles and residual range. Figure 3 shows typical resultant tracks for the 1 h etch time in Figure 2. They display a variety of etch geometries. When viewed in projection under the microscope, the distribution of longest versus minor axis track sizes fall into a well-defined acceptance envelope - Figure 4. For these particular etch conditions, the maximum minor axis diameter of etched tracks is approximately 20 µm. Longer etch times produce larger tracks, but structural features of the track geometry will become progressively lost.

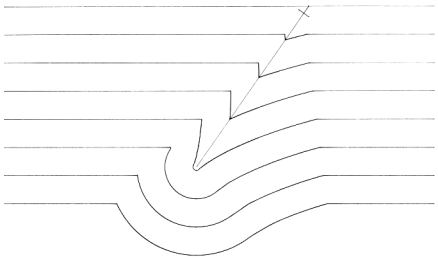


Fig 1: Growth of etch track along latent α-particle track.

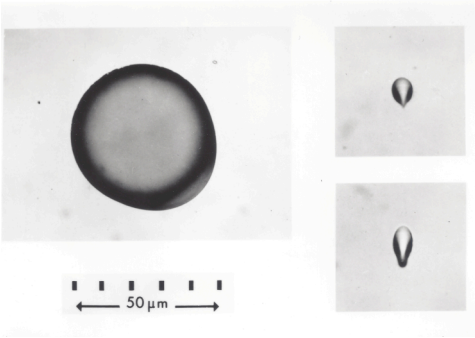


Fig 2: Example α-particle etch tracks for quite different etch times.

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Fig 3: photographs of α-particle tracks in TASTRAK plastic.

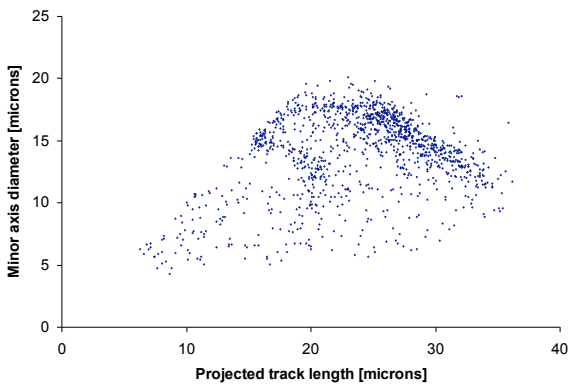

Figure 4:Acceptance envelope of etch track sizes

Technical specification

V_t varies as a function α-particle residual range in the plastic - Figure 5. As etching progresses up to the etch time employed, all etch track geometries result from the variation along the α-particle track of the ratio V_t/V_b and any enlargement once track etching has reached the end of the particle range.

The basic requirement for revealing α-particle tracks is: $V_t \sin\delta > V_b$, where δ is the incident dip angle of the track. This means that like all plastic track detectors, TASTRAK possess a cut-off dip angle for track detection. From Figure 5 this depends on α-particle residual range in the plastic and the etch conditions employed. The limiting value for α-particles is 20°.

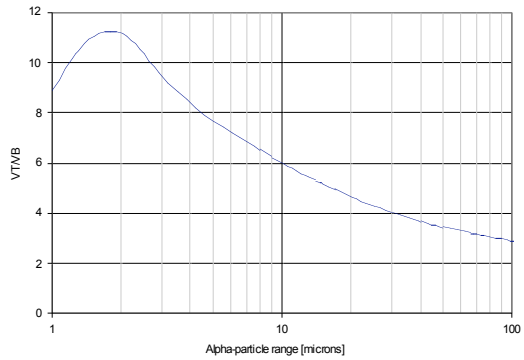

Fig 5 Typical V_t - residual range curve for α-particle tracks in TASTRAK plastic.

Response specification.

- All natural α-particles are recorded at their full energy in the detector, with a limiting cut-off angle of 20° for our standard recommended etch conditions.
- Response is fully isotropic within the angular cut-off window.
- Typical bulk etch rate, V_b in 6.25 M NaOH: 1.8 μm. h^{-1} at 75 °C; 10 μm.h^{-1} at 98 °C.
- Typical track-to-bulk etch rate ratio at 10 μm α-particle residual range, $V_{t(10)}/V_b$: 6.0.

Recommended etch conditions for radon detectors.

- Etchant: 6.25 M NaOH
- Etch times: 6 hours at 75 °C or 1 hour at 98 °C

These recommendations match the standard settings of the TASL*Image* radon dosimetry system. For other read-out systems, etch times and etchant concentrations may be chosen according to user preference.