A Comparison between an Automatic Track Reader Using Alfascan(TM)[1] SoftWare and Manual Counting

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"A Comparison between an Automatic Track Reader Using Alfascan* Software and Manual Counting", John R. Peggie
(In-house paper written by ARL, the Australian Radiation Laboratories, a Federal Australian department charged with national monitoring of ionising and non-ionising radiation. This paper very favourably compares the performance of our automated image-processing system, based on the AS3000 stage, with that of human operators in the process of analysing CR39 radiation badges which have been subjected to alpha particle radiation).
*Alfascan was the DOS-based precursor of our AutoScope software.

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[1] AlfaScan (TM) software by Autoscan Systems Pty Ltd P.O. Box 112 Ormond Victoria, Australia.

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Introduction

The Australian Radiation Laboratory has offered a radon analysis service to the public for some years through its Personnel Radiation Monitoring Service section. Any person or organisation can make a request to have an estimate made of the concentration of radon gas present in their home or office. The method normally used to evaluate the gas concentration involves placing a small plastic jar containing a piece of polycarbonate (CR-39) in the home for a period of three months. CR-39 is known as a Solid State Nuclear Track Detector (SSNTD). When CR-39 is struck by alpha particles, the material is damaged or altered in the immediate vicinity of the collision path. This damaged material is more susceptible to chemical attack than the undamaged bulk of the material. At the end of the exposure period in a dwelling, the material is etched by immersion in 6.25 Molar KOH at temperature of 70°C for 6 hours. This causes small pits in the material to develop which are due to the alpha particle collisions. They can be seen through a microscope at a magnification of approximately X80.

The number of pits or tracks per unit area is proportional to the average concentration of radon gas present in the atmosphere over the period of exposure. The small jar housing the SSNTD is kept closed during the exposure period. Radon gas enters the jar by diffusing along the screw thread of the jar lid. The calibration of these devices was carried out in the ARL radon chamber in which the radon was maintained at a known concentration for the duration of the exposure. A typical calibration factor is approximately 0.12 tracks cm^{-2} Bq^{-1} day m^{-3}.

When the exposed SSNTD is received from the user, it is etched along with a CR-39 detector that has been given a known exposure in the radon chamber at ARL. This standard or reference detector is counted using the same magnification as those

detectors issued to the public for radon analysis. An unexposed detector, which is kept in an environment free of radon gas, serves as an estimate of the detectors background radiation exposure. An identical number of areas are counted for the standard, background and issued detectors. The results are then calculated using expression (1) below

$$E=\frac{(T_S-T_B)}{(T_R-T_B)}A \qquad (1)$$

where E is the exposure given to the sample detector. ($Bq.day.m^{-3}$)

T_s is the number of tracks per unit area for the sample detector given an unknown exposure.

T_B is the number of tracks per unit area for the background CR-39. This is a detector that has not been exposed and has been kept in a radon free enclosure.

T_R is the number of tracks per unit area for the reference CR-39. The reference detector is one that is given a known exposure in the radon chamber.

A is the exposure given to the reference detector ($Bq.day.m^{-3}$)

The number of tracks is determined by counting the tracks manually using a microscope with a magnification of approximately X80. This is carried out for each CR-39 detector by five operators. The results are averaged and the exposure determined. Counting manually is time consuming and tedious. When the automatic counting system became available it was necessary to compare its performance against the manual operators.

A comparison was made between manual and automatic counting using six CR-39 detectors etched under the same conditions in November 1992. Five of the detectors measured were sent from the laboratory to people requesting radon analysis. The sixth detector was the standard Rn5450, which was exposed in the radon chamber for two days. The total exposure was 13.5 $kBq.day/m^3$.