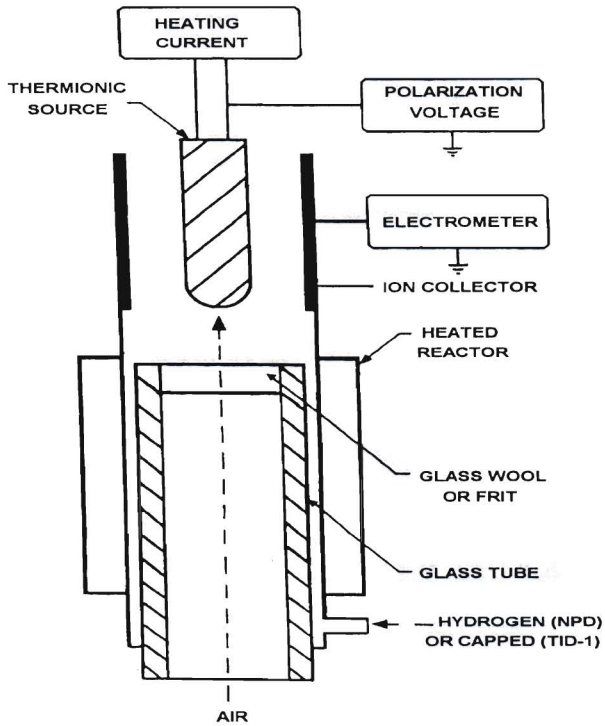
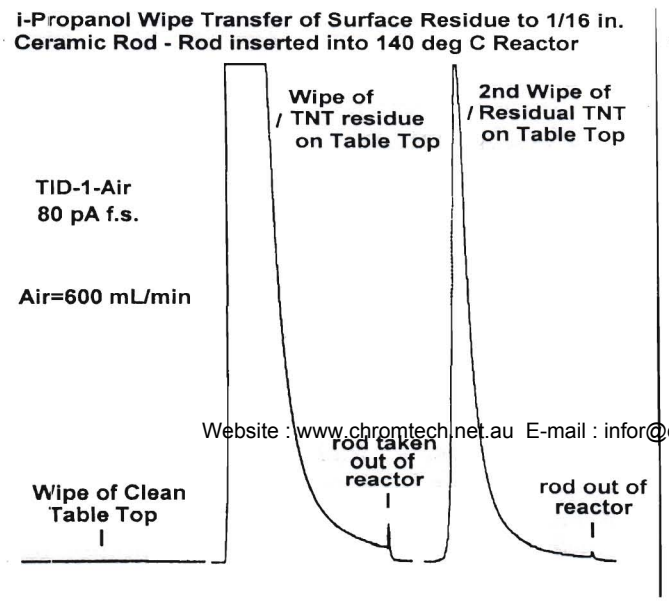
Reactor Thermionic Ionization Analysis (RTIA)

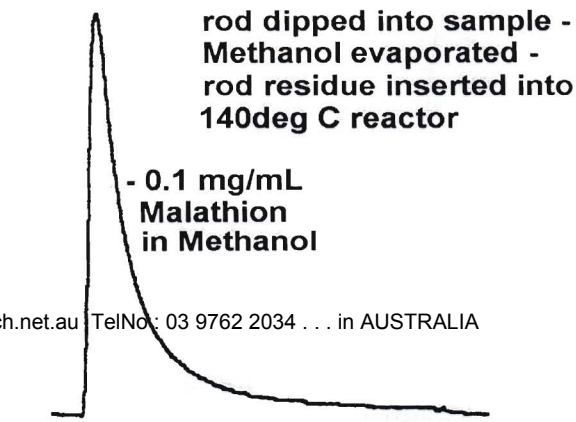
selective TID/NPD transducer screening of vapors evolved from THERMAL DESORPTION/OXIDATION of nonvolatile liquid residues or solid sample constituents

Background: Thermal desorption continues to be an increasingly popular means of preparing real world samples for subsequent analysis by gas chromatography. Among the many different types of GC detectors, TID and NPD detectors have the distinctive characteristic that they can provide chemical species selectivity using Air as the primary detector gas. Consequently, these detectors are well suited to non-GC chemical screening applications where the gas environment is simply ambient Air drawn through a TID/NPD transducer by a sampling pump. In an **RTIA** configuration, such a transducer is preceded by a heated reactor chamber into which are inserted solid samples packed into a glass tube or liquid sample residues on a ceramic rod. The TID or NPD transducer provides selective responses to vapors evolved from thermal desorption and/or oxidation of the samples. At low reactor temperatures, thermal desorption usually accounts for most detected signals, while at high temperatures oxidative sample decomposition products often provide large signals. Good examples of the oxidative detection processes are large TID-1 signals from oxidation of sugars and proteins. For TID-1 and TID-3 thermionic detection, only Air is required as the operating gas, while for NPD a small flow of Hydrogen has to also be introduced into the incoming Air.





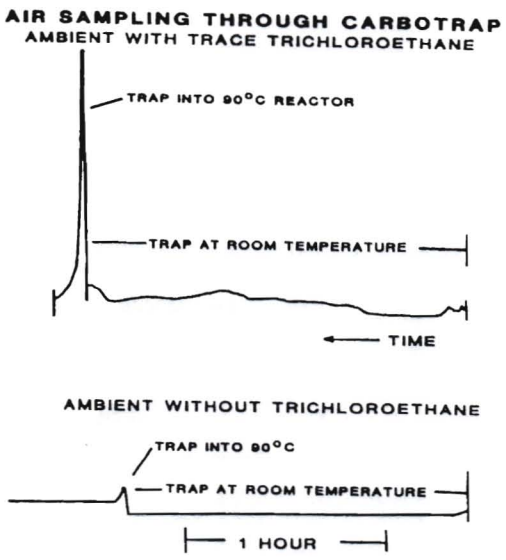
dried TNT residue on a table top wiped with an iso-propanol pad and transferred to ceramic rod.



small quartz rod dipped into a 0.1mg/mL solution of Malathion in Methanol.

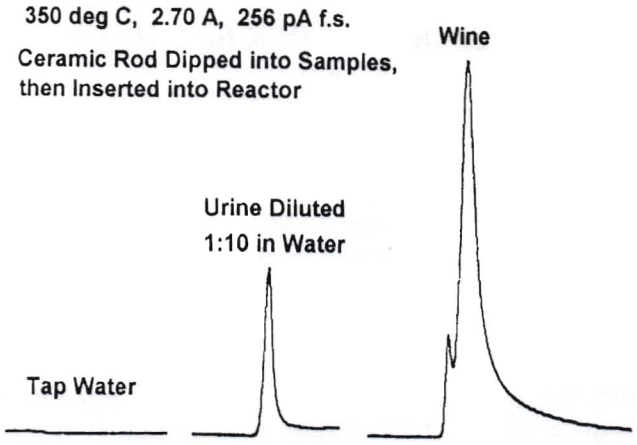
Examples: RTIA/TID-1 Analyses

TRAP-DESORB-DETECT

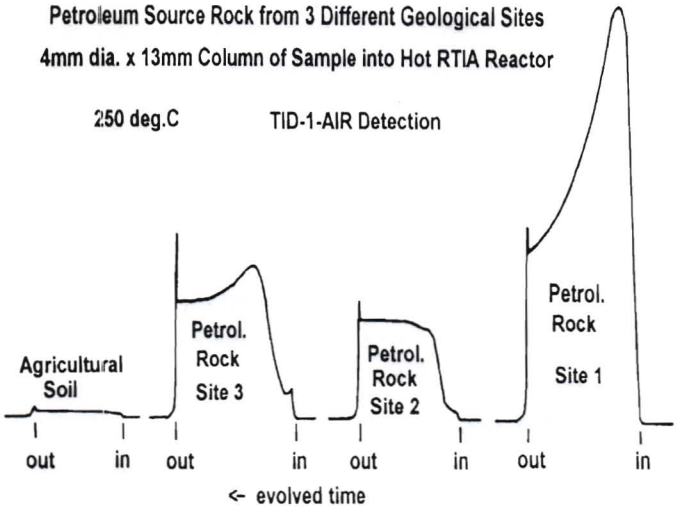


RTIA/TID-1. 1 L/min ambient Air - 1 hour through unheated trap, then trap into 90°C reactor.

DESORB/OXIDIZE & DETECT

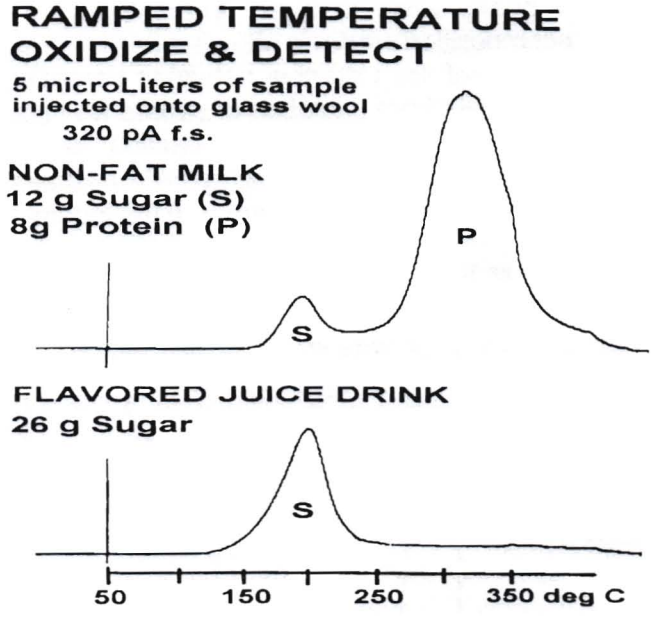


water based liquid samples - ceramic sample rod moist with both water and residual organic material when inserted into the reactor - signals mostly due to oxidation products of the organics.

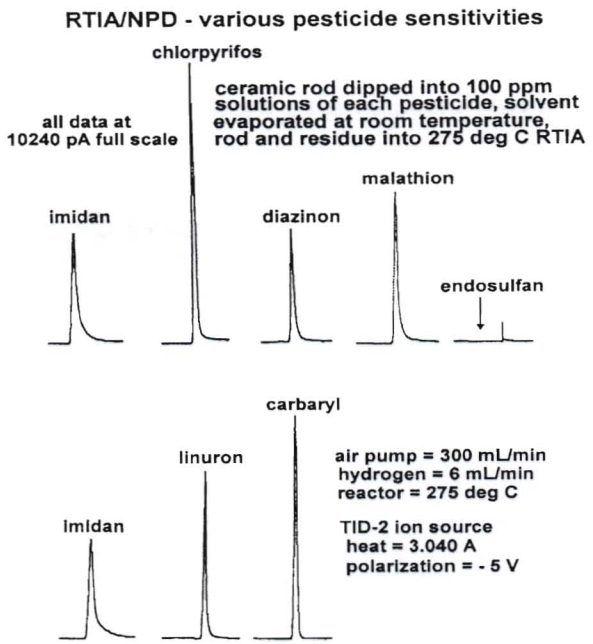


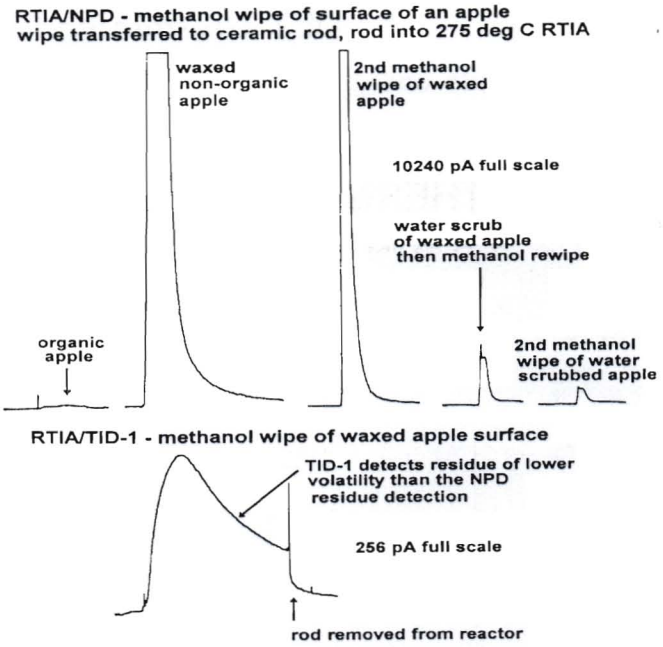
crushed rock sample loosely packed into 5 ½ inch long column inside 6mm OD x 4mm ID glass tube - tube inserted and sealed into reactor so incoming Air flowed through tube ID and the samples - sample tubes inserted/removed as indicated - peak in signals followed by decay indicates constituent being volatilized and removed - steady signal plateau indicates constituent vapor pressure, but no volatilization/removal.

RAMPED TEMPERATURE OXIDIZE & DETECT



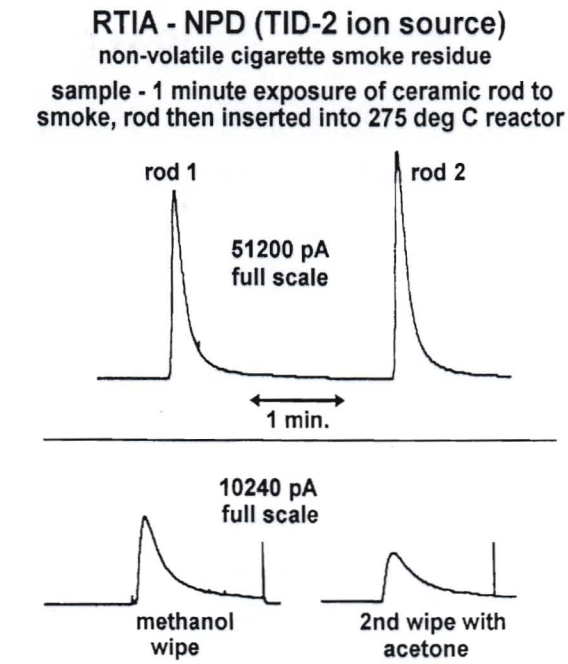
variation of the RTIA technique - TID-1 detector mounted onto a GC - 2 inch long 6mm OD x 4mm ID open end glass tube packed with glass wool located inside GC oven and connected to detector inlet - sample pump at detector exit pulled Air through the system - liquid samples injected onto glass wool - column oven temperature programmed to provide profile of oxidation product signals vs. temperature.



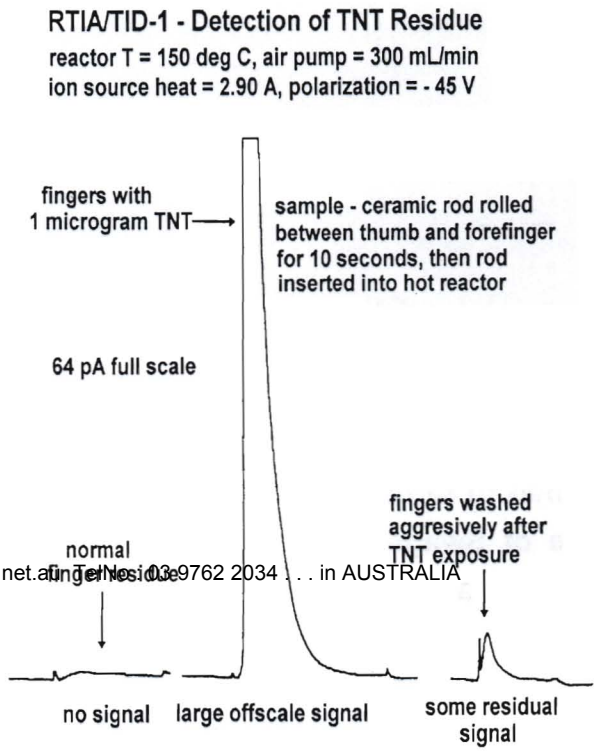


RTIA/NPD detects N and P pesticide residues, but not Endosulfan which contains lots of Cl and no N or P.

RTIA/NPD & RTIA/TID-1 detection of an Apple's Wax coating. Sharp rise and fall of NPD signal corresponded to a more volatile component than the slower oxidizing components detected by TID-1 (TID-1 signal likely due to CH_2 groups in the wax compounds - NPD signal??)



sample - inside surface of glass bell jar wiped with moistened chemwipe after 5 minute exposure of bell jar interior to smoke from a smoldering cigarette, bell jar wipe transferred to ceramic rod which was then inserted into RTIA reactor



RTIA/NPD detection of "Third Hand Smoke" - non-volatile residue deposited on surfaces exposed to Second Hand Smoke.

RTIA/TID-1 detection of a TNT trace residue on a finger.