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# IMS Based Detection of Homemade Explosives

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## New Developed IMS-Technology

### Problem

Due to improved control of the distribution of commercial and military used explosives the so called homemade explosives are obviously of increasing interest. IUT's analytical department studied the behaviour of TATP and its detection by different analytical methods.

### The Vapour Pressure of TATP

TATP sublimates and its vapour pressure in dependence on temperature can be calculated by means of the formula published by Oxley et al. [1]:

$$\log p = A - \frac{B}{T}$$ (T = temperature in K; A, B = constants)

The formula is valid between 12 and 60°C. We used it for lower temperatures also and calculated vapour pressures given in table 1:

| T in °C | p in Pa | C in ppm |
|---|---|---|
| -10 | 0.012 | 0.118 |
| -5 | 0.031 | 0.31 |
| 0 | 0.076 | 0.75 |
| 5 | 0.181 | 1.79 |
| 10 | 0.418 | 4.13 |
| 15 | 0.937 | 9.2 |
| 25 | 4.331 | 42.74 |
| 50 | 131 | 1116 |

Table 1: Vapour pressure/concentration vs. temperature

Relatively high concentrations of TATP in ambient air at normal conditions open up good chances for IMS detection.

### The Synthesis of TATP

The synthesis of TATP can be done in presence of HCl or $H_2SO_4$ as catalyst.

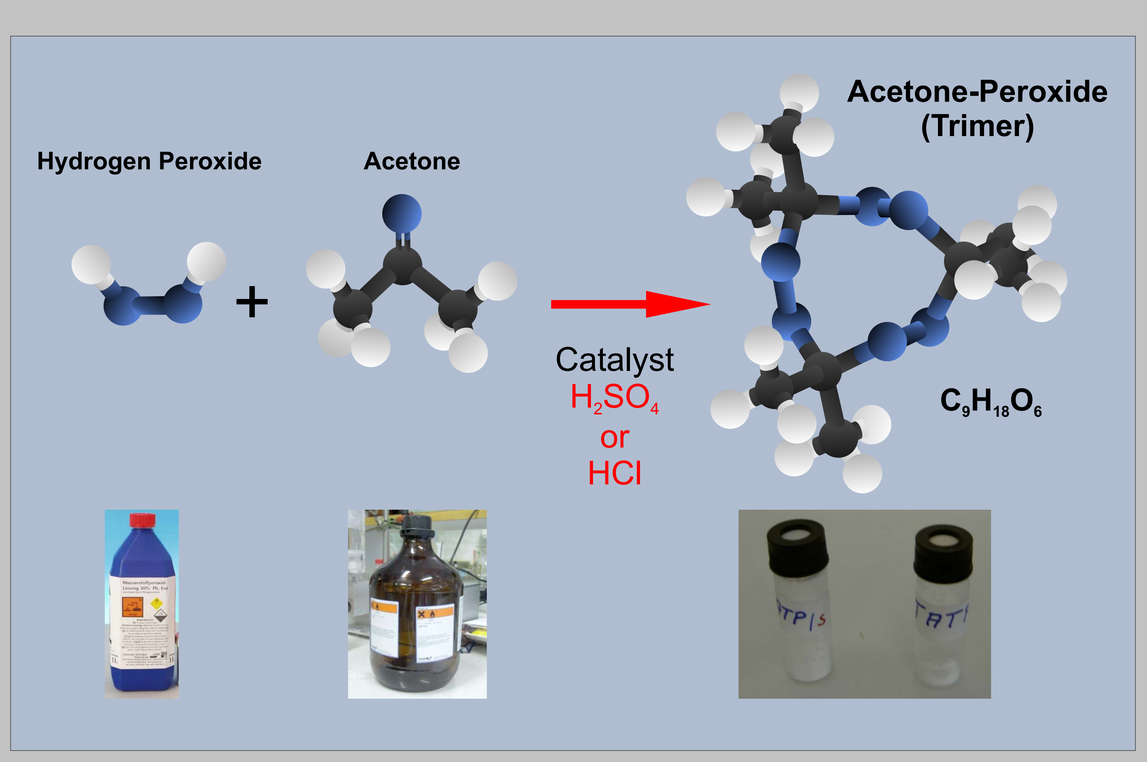


Figure 1: Synthesis of TATP with $H_2SO_4$ or HCl as catalyst

Citation:

[1] J. C. Oxley et al., *Determination of the Vapour Density of Triacetone Triperoxide (TATP) Using a Gas Chromatography Headspace Technique*, Propellants, Explosives, Pyrotechnics Vol 30 (2005) 127
[2] IUT Institut für Umwelttechnologien GmbH, private communication, 2007

### IMS Spectra of TATP

TATP vapour forms the following spectra using special IUT design for explosives detection. It was validated that both types of TATP give identical peaks in the positive mode at $t_R$ = 1.1 as shown in figure 2. The negative mode (figure 3) shows an ion at $t_R$= 0.89 which is typical for chlorinated hydrocarbons like phosgene.

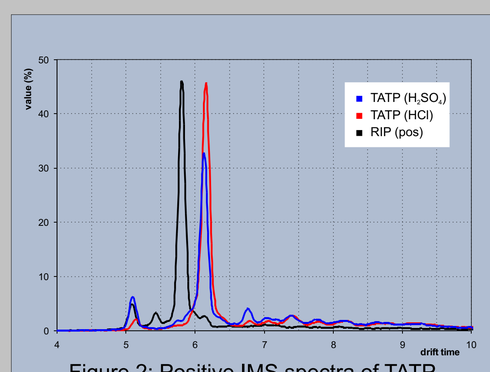


Figure 2: Positive IMS spectra of TATP

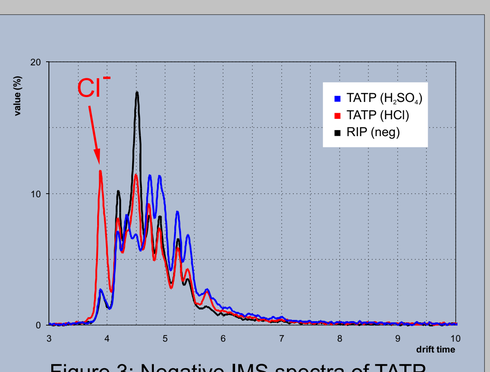


Figure 3: Negative IMS spectra of TATP

Figure 4 shows the calibration curve of TATP, measured with IUT IMS.

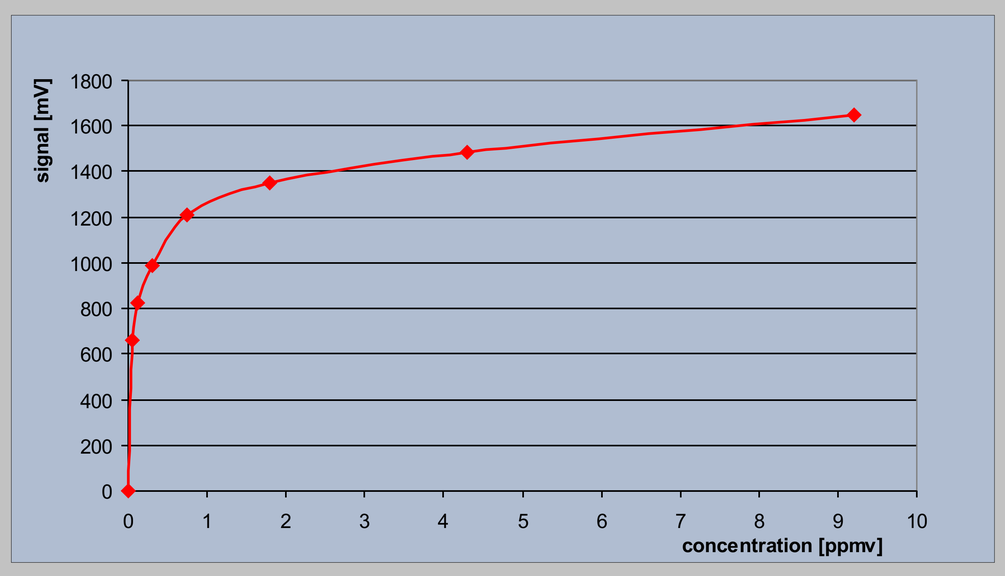


Figure 4: Calibration curve of TATP

The minimal detectable concentration (MDC) was estimated to 0.4 ppb [2].

### New Equipment

IUT designed a new high temperature drift tube, which is keeping the resolution power of better than 50 of its precursor. The system has been tested up to 150 °C. A photo of the new drift tube is shown in figure 5. The equipment designed for explosives determination including a desorber unit is shown in figure 6.

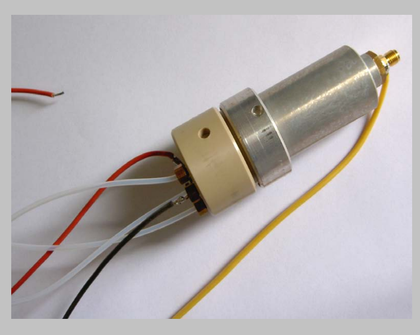

Figure 5: Drift tube


Figure 6: IMS with desorber

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