Exploration of New Low-Pressure GC Columns for Food and Environmental Emerging Contaminants

Jana Hepner[1], Jan Pschierer[1], Whitney Dudek-Salisbury[1], Jaap de Zeeuw[1], Chris English[1]

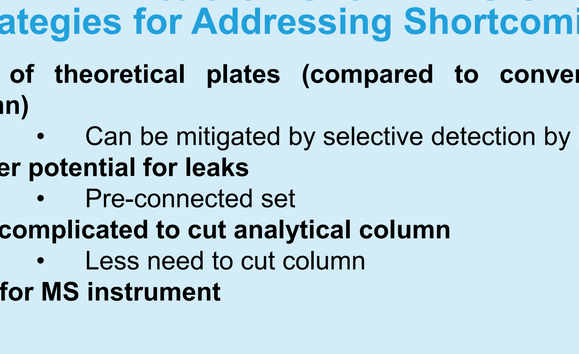
[1]**Restek Corporation,** 110 Benner Circle; Bellefonte, PA 16823, USA; jana.hepner@restek.com

Introduction

The Low-Pressure GC (LPGC technique) has been successfully used in the past for pesticide residues' analysis. However, the technique is very versatile, and it allows for other applications, especially if different column phases are used. So far, the majority of the applications have been using the "5"-type phase (95% dimethylpolysiloxane, 5% diphenyl polymer). To expand on the previous applications, four additional column phases were selected (cyanopropylphenyl dimethylpolysiloxane; 50% dimethylsiloxane, 50% diphenyl; 65% dimethylsiloxane, 35% diphenyl; and trifluoropropylmethyl polysiloxane phases) to analyze various food and environmental contaminants, such as nitrosamines, alkylfurans, phthalates, arylamines and fluorotelomer alcohols.

The LPGC techniques provided significant reduction in run times (up to 3.3x faster runs) and helium consumption reduction (up to 81% less helium used), while keeping an acceptable resolution.

LPGC Setup



Column set is delivered pre-connected in the box.
Only extra consumable needed is 0.5 mm or 0.8 mm vespel/graphite ferrule for MS transfer line

LPGC Advantages

Fast analysis with short 0.53 mm or 0.32 mm capillaries
- Short analysis times
- Potentially increased sensitivity
- Potentially higher capacity

Peak width enough for any type of MS

Lower elution temperatures
- Elution at 50-80°C lower temperatures
- Lower bleed

All stationary phase chemistries

Standard injection techniques, high volume injections

Limitations of LPGC
Strategies for Addressing Shortcomings

Loss of theoretical plates (compared to conventional column)
- Can be mitigated by selective detection by MS

Greater potential for leaks
- Pre-connected set

More complicated to cut analytical column
- Less need to cut column

Need for MS instrument

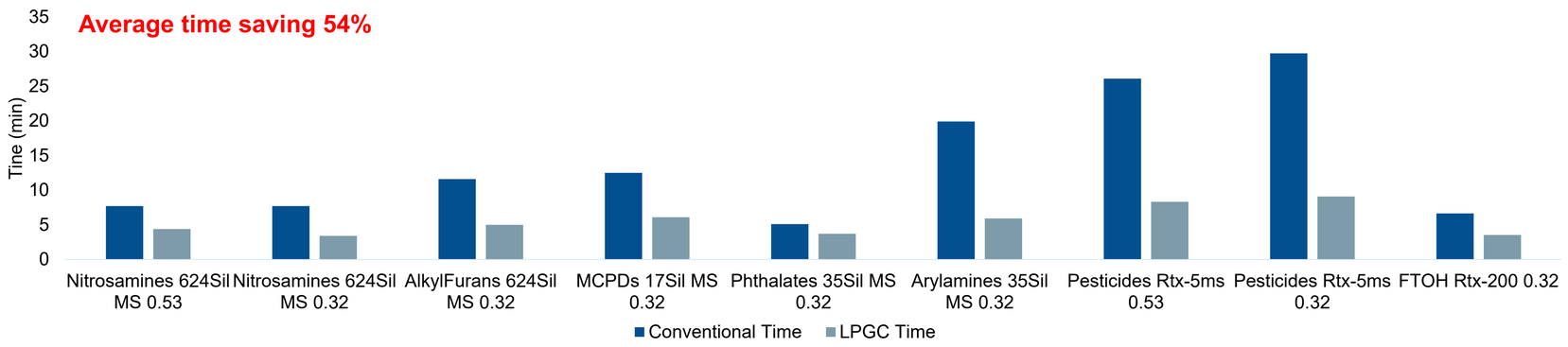
Can I use LPGC for my application?
Questions to ask yourself

Is MS a suitable detector?
- Vacuum is needed

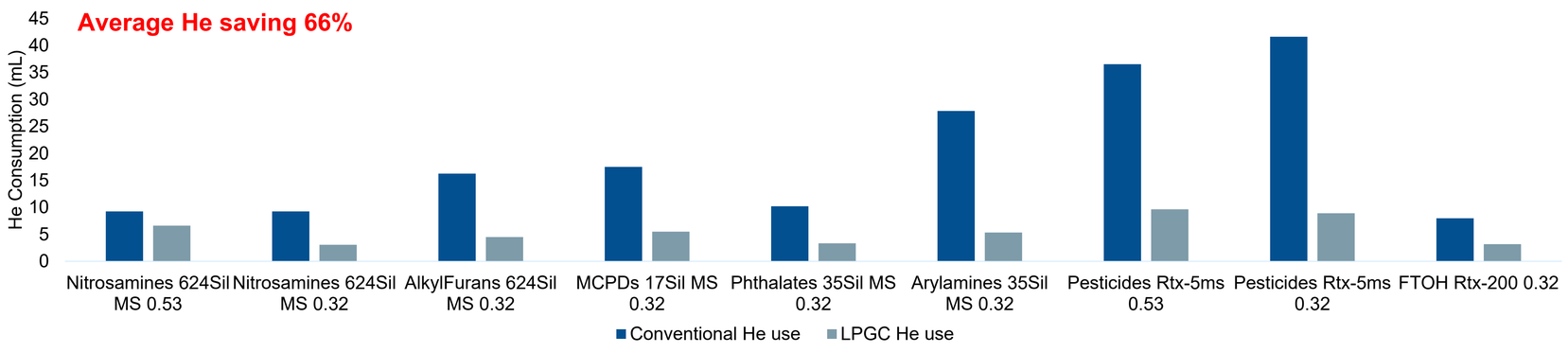
What kind of column is the conventional method using?
- In general, most conventional methods with 30 m column can be translated to LPGC method

Are there isobars to resolve?
- What level of resolution is needed?
- What is the resolution in the conventional method? If it is above 2.0, usually we can get peaks resolved

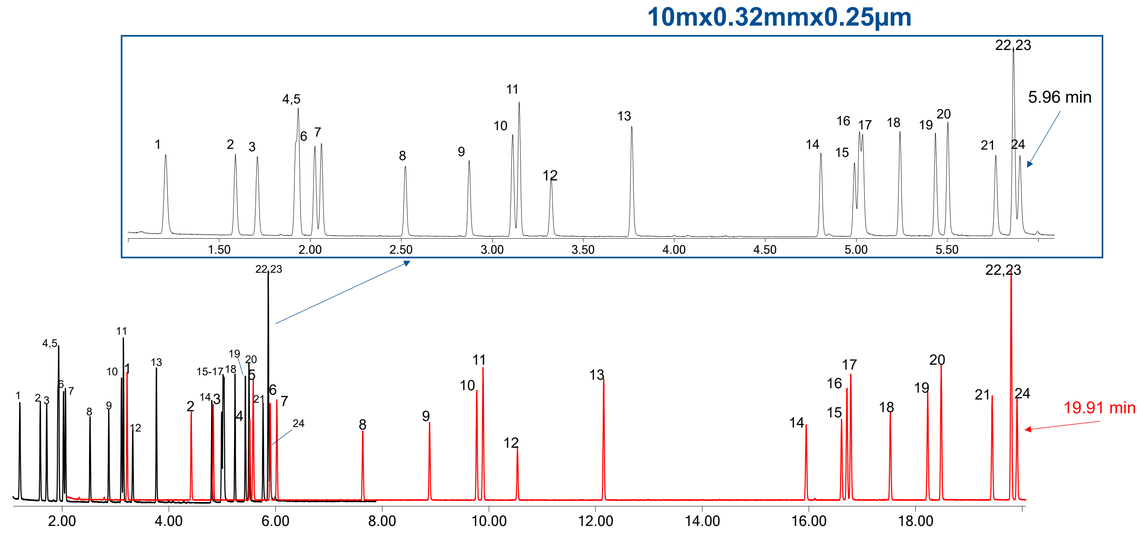
Time Savings with LPGC



Helium Savings with LPGC

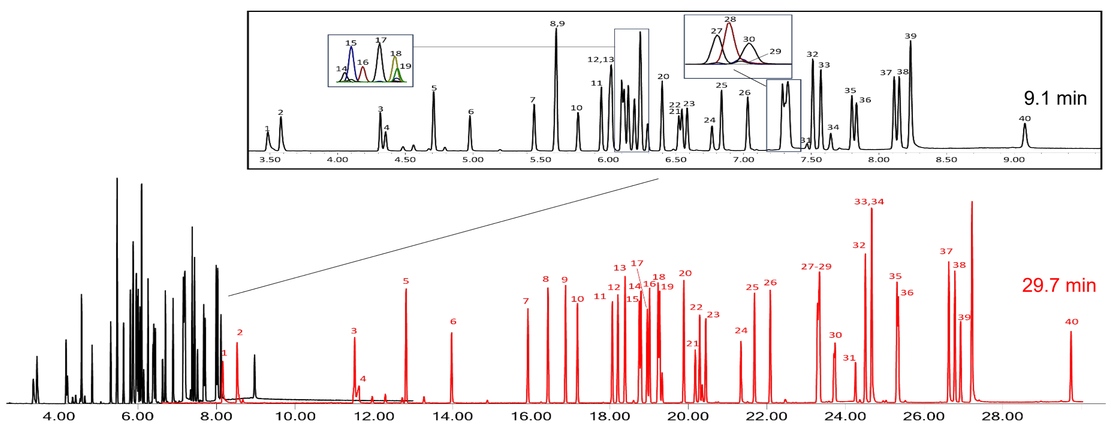


LPGC Rxi-35Sil MS Arylamines
10mx0.32mmx0.25µm



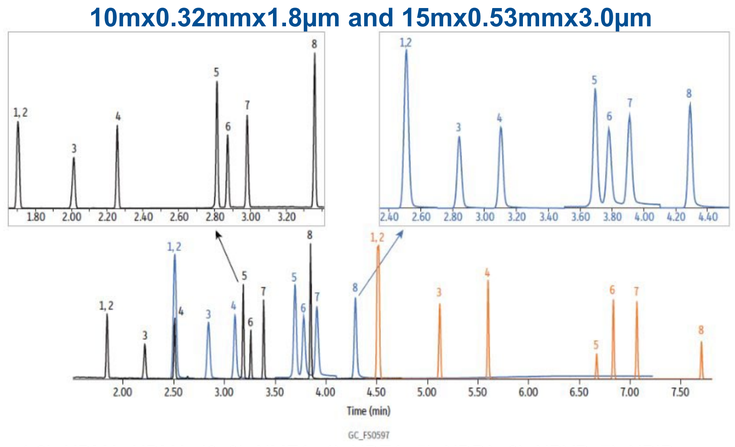
1) o-Toluidine
2) o-Anisidine
3) 4-Chloroaniline
4) p-Cresidine
5) 2,4,5-Trimethylaniline
6) 3-Chloro-o-toluidine
7) 4-Chloro-o-toluidine
8) 2,4-Diaminotoluene
9) 2,4-Diaminoanisole
10) 2-Naphthylamine
11) 2-Aminobiphenyl
12) 2-Amino-4-nitrotoluene
13) 4-Aminobiphenyl
14) p-Aminoazobenzene
15) 4,4'-Oxydianiline
16) 4,4'-Diaminodiphenylmethane
17) Benzidine
18) o-Aminoazotoluene
19) 3,3'-Dimethyl-4,4'-diaminodiphenylmethane
20) 3,3'-Dimethylbenzidine
21) 4,4'-Thiodianiline
22) 3,3'-Dichlorobenzidine
23) 4,4'-Methylenebis (2-chloroaniline)
24) 3,3'-Dimethoxybenzidine

LPGC Rtx-5ms Pesticides
10mx0.32mmx1.0µm



1) Methamidophos
2) Dichlorvos
3) Mevinphos
4) Acephate
5) o-Phenylphenol
6) Omethoate
7) Dimethoate
8) gamma-BHC
9) Diazinon
10) Chlorothalonil
11) Vinclozolin
12) Carbaryl
13) Metalaxyl
14) Pirimiphos methyl
15) Methiocarb
16) Malathion
17) Dichlofluanid
18) Fenthion
19) Chlorpyrifos
20) Cyprodinil
21) Thiabendazole
22) Captan
23) Folpet
24) Imazalil
25) Myclobutanil
26) Endrin
27) 4,4'-DDT
28) Endosulfan sulfate
29) Fenhexamid
30) Propargite
31) Dicofol
32) Iprodione
33) Bifenthrin
34) Fenpropathrin
35) Phosalone
36) Azinphos-methyl
37) cis-Permethrin
38) trans-Permethrin
39) Coumaphos
40) Deltamethrin

LPGC Rxi-624Sil MS Nitrosamines
10mx0.32mmx1.8µm and 15mx0.53mmx3.0µm



1,2) NDMA, NDMA-d6, 3) NMEA, 4) NDEA, 5) NDPA, 6) NPYR, 7) NPIP, 8) NDBA

Conclusions

Multiple new LPGC column kit were tested
- Analysis up to 3.3x faster
  - Limited by the temperature program
- Up to 81% less helium used
- Acceptable resolution

Expanding the LPGC applications beyond pesticides

No need to change instrumentation
- Now compatible with all instruments

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