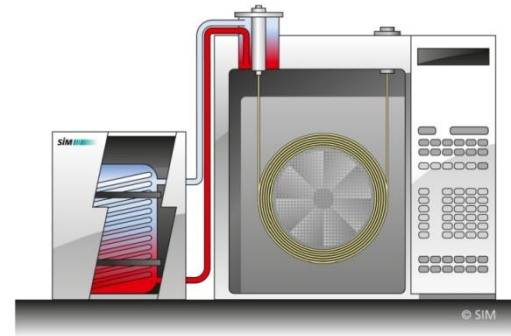


COOL-CUBE – Multi Cooling Device



→ for GC modules



COOL-CUBE – Multi Cooling Device



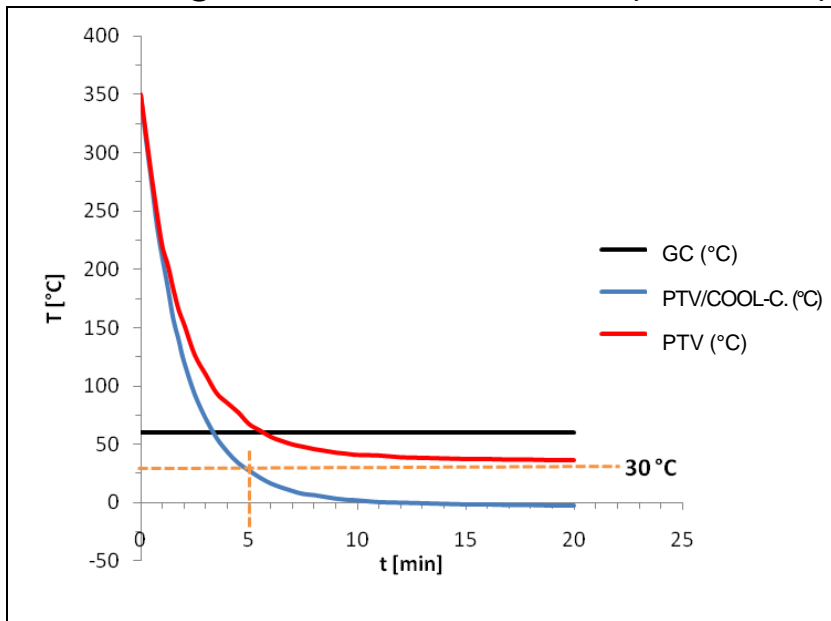
- compressor cooling for
 - all temperature controlled **GC inlets**
 - Agilent **G4514A** autosampler tray
 - SIM **CryoTrap** and **PICK-UP**
 - SIM **ICE-DOOR**
- Agilent-PTV, -MMI down to 0 °C
SIM-PTV down to - 20 °C
(at oven temperature < 55 °C)

- fast and convenient without the coolants LN₂, LCO₂
- energy-saving due to discontinuous cooling
- maintenance free

COOL-CUBE/Agilent-PTV: Temperature Profile

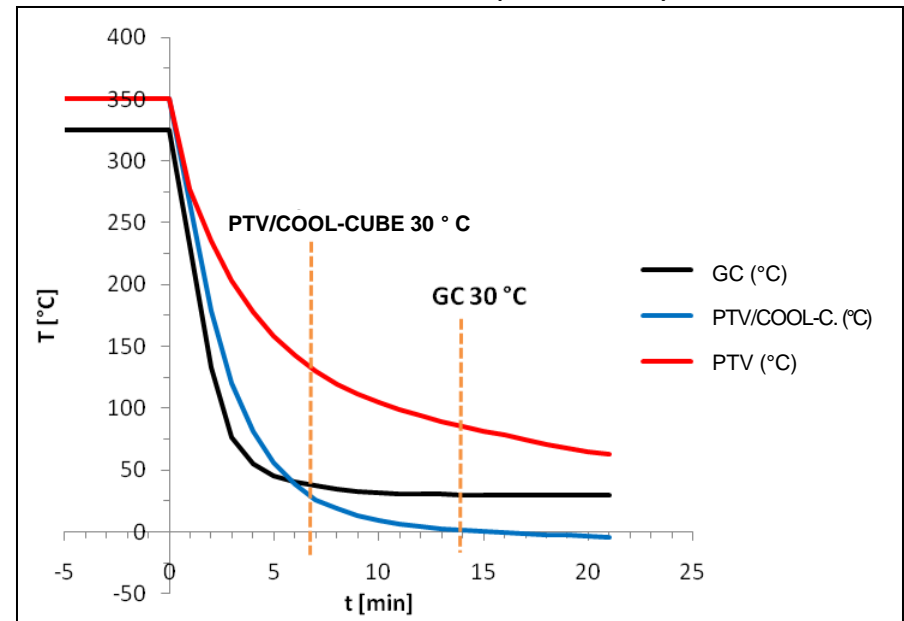
Agilent-PTV

cooling **with** COOL-CUBE (blue line) and **without** COOL-CUBE (red line):



7890 GC with oven constant 60 °C,
PTV_{initial}: 350 °C

➔ at a constant temperature of 60 °C,
the PTV with COOL-CUBE can be
cooled down to **30 °C** within only
5 minutes



7890 GC with oven: 325 °C (for 15 min), fast
cool down mode to 30 °C, PTV_{initial}: 350 °C

➔ cooling down the PTV with COOL-CUBE
to **30 °C** needs only **6.5 min** ,
simultaneously with an oven temperature
of 30 °C, the PTV reaches **0 °C (14 min)**

COOL-CUBE with ICE-DOOR

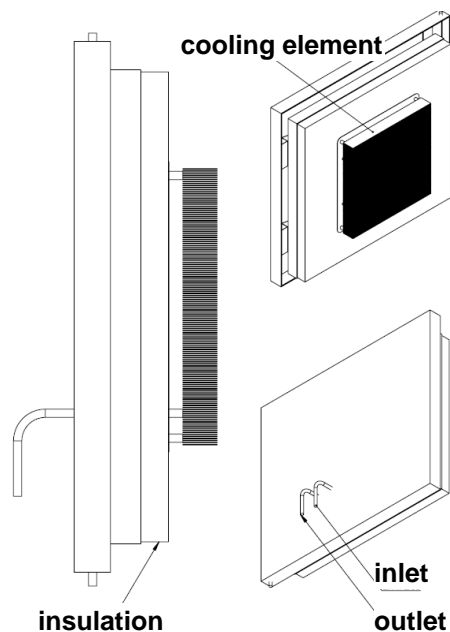


to cool down
Agilent 7890 GC oven



to cool down
Shimadzu GCMS-QP2010Ultra
GC oven

ICE-DOOR to cool down the GC oven



- cooling element is placed at the inside of the oven door
- fast cooling down of the GC oven together with SIM COOL-CUBE
- ➔ shorter cycle times, higher throughput
- ➔ gas analysis at low temperatures
- ➔ cooling down to 0 °C without the coolants LN₂, LCO₂
- ➔ closed system, maintenance-free

Application: Composition of Racing Fuel

analysis problem

→ separation of cyclopentane
and 2,3-dimethyl-butane

solution

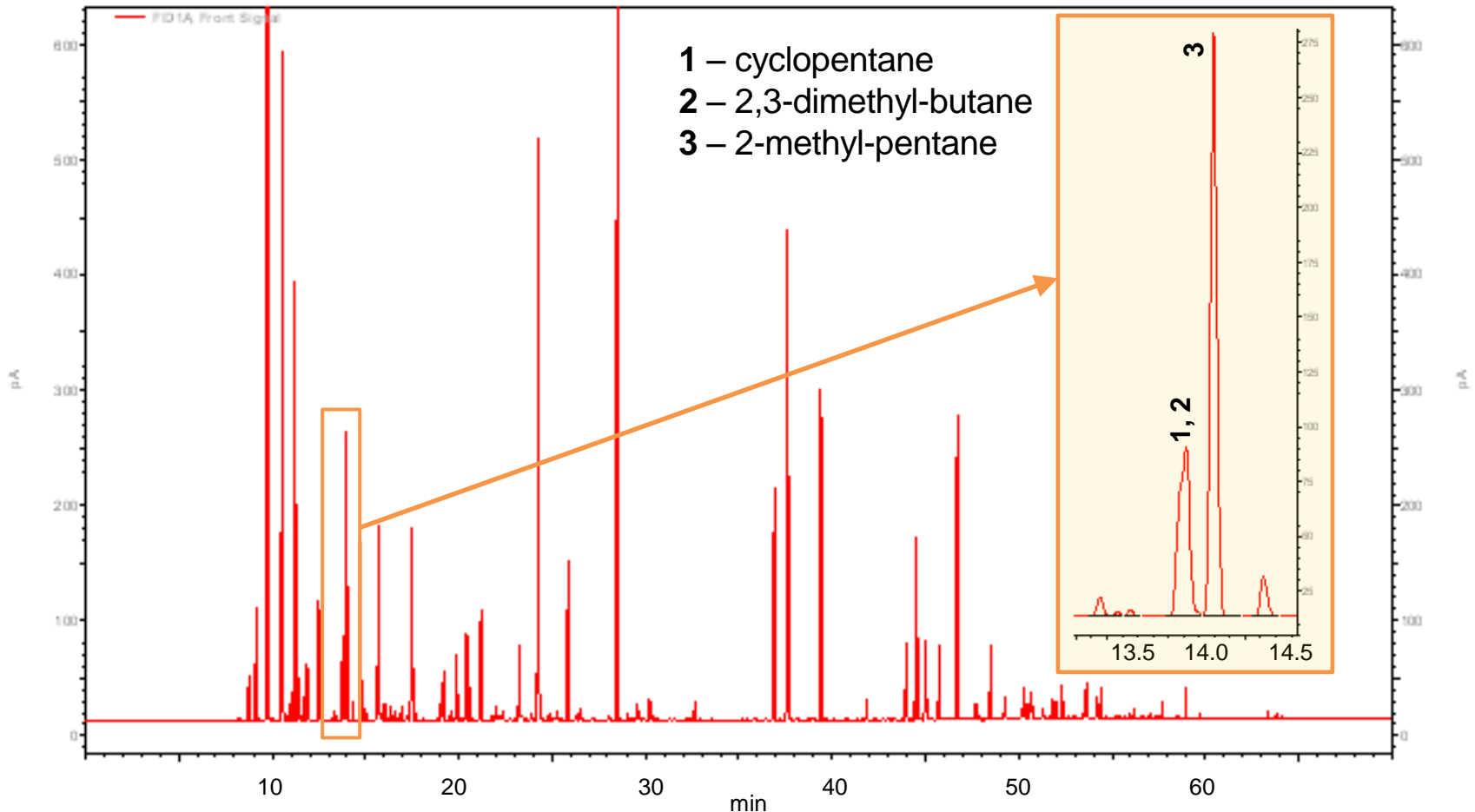
→ GC oven cooling with



ICE-DOOR
and
COOL-CUBE

Racing Fuel Analysis without ICE-DOOR

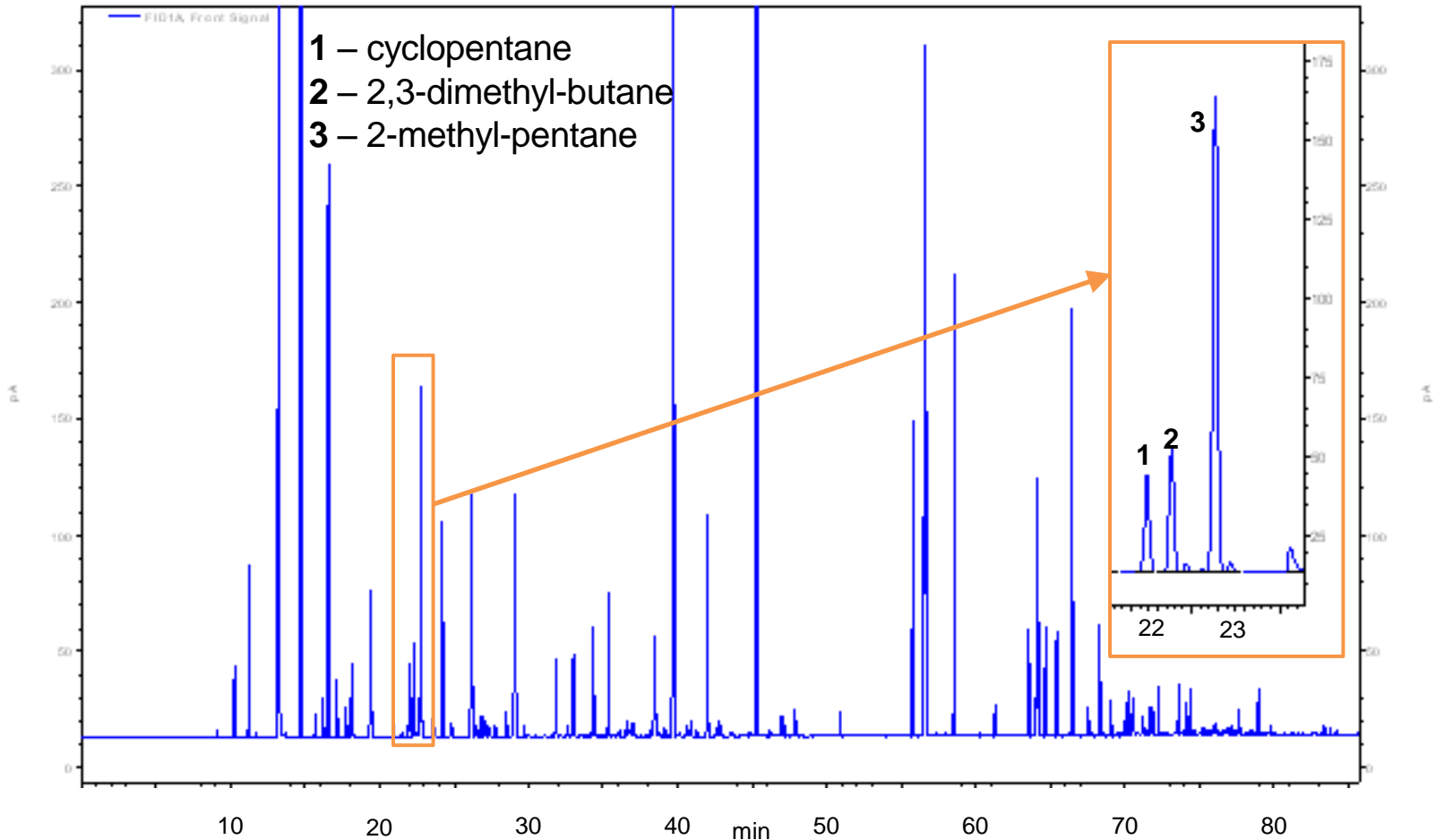
start temperature 30 °C for 15 min ⇒ **no separation** of cyclopentane and 2,3-dimethyl-butane



Agilent 7890 GC, column: HP Pona (100m x 0.25mm x 0.2 μ m); carrier gas: H₂ (1 ml/min); injection volume: 1 μ l
temp. program: 30°C for 15 min, 1.5°C/min to 60°C, 5°C/min to 120°C, 10°C/min to 240 °C; detection: FID

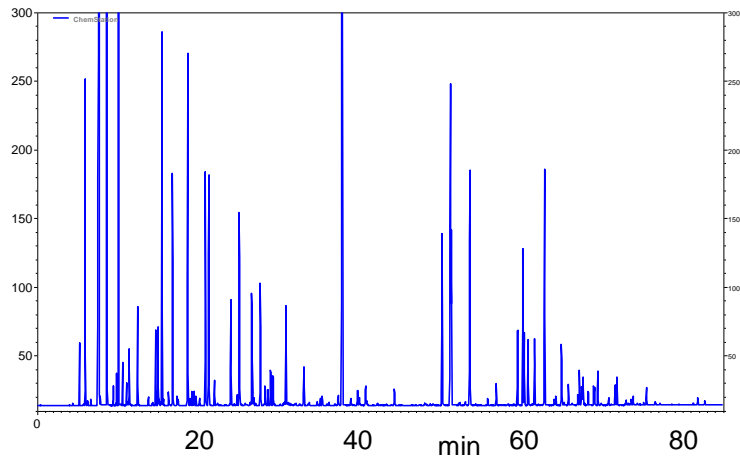
Racing Fuel Analysis with ICE-DOOR

start temperature 0 °C for 10 min ⇒ **separation** of cyclopentane and 2,3-dimethyl-butane



Agilent 7890GC with ICE-DOOR + SIM COOL-CUBE, column: HP Pona (100m x 0.25mm x 0.2µm); carrier gas: H₂ (1ml/min); injection volume: 1 µl; temp. program: 0°C for 10 min, 1.5°C/min to 60°C, 5°C/min to 120°C, 10°C/min to 240°C; detection: FID

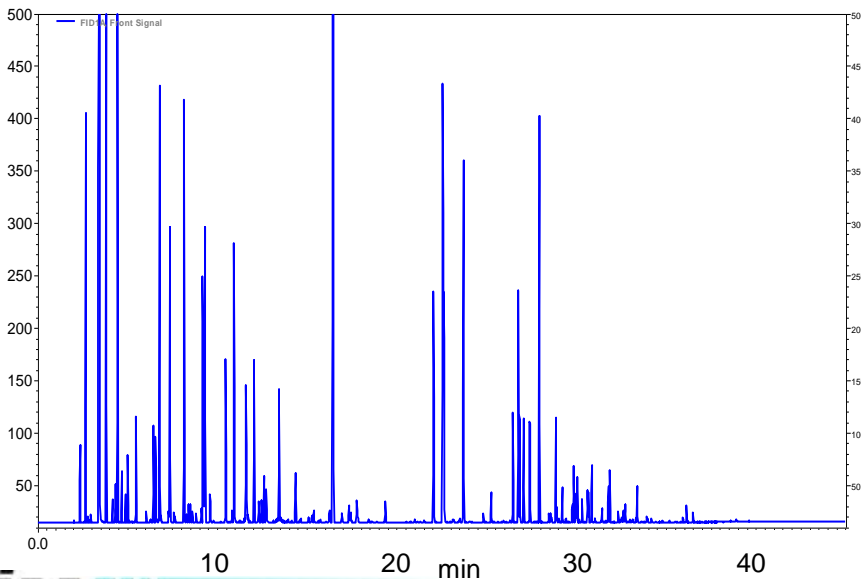
Analysis of petroleum acc. to ASTM D 5134



Agilent 6890 GC with CO₂ cooling, column: HP-PONA (50m x 0.2mm x 0.5µm); carrier gas: He (1 ml/min); injection volume: 1 µl; temp. program: 0°C start, 1.5°C/min to 70°C, 3 °C/min to 180°C, 11.66 min (run time 94.99 min); detection: FID

ASTM D 5134 – standard method

carrier gas: **He**
oven cooling: **LCO₂**
run time: **95 min**



Modification for carrier gas H₂ with ICE-DOOR cooling

carrier gas: **H₂**
oven cooling: **ICE-DOOR / COOL-CUBE**
run time: **45 min**

Agilent 7890 GC with ICE-DOOR and COOL-CUBE, column: HP-5 (50m x 0.2mm x 0.5µm); carrier gas: H₂ (2ml/min); injection volume: 1 µl; temp. program: 0°C start, 3.14°C/min to 70°C, 6.299 °C/min to 180°C, 5.5 min (run time 45.256 min); detection: FID

Analysis of petroleum acc. to ASTM D 5134

Pros of the modified method ASTM D 5134:

- no CO₂- necessary for starting temperature 0 °C:
 - ➔ safe and easy-to-use
 - ➔ no need for a stock of liquid coolants

- replacement of carrier gas helium by hydrogen:
 - ➔ cost-saving (esp. because the need of a split 500:1 for 2 min)
 - ➔ better peak shape compared to He
 - ➔ better separation, same elution order
 - ➔ halve run time (45 min – H₂, 90min – He)