Portable MS design

Analyzing systems: **Mass Spectrometer [1,2]** - slide 1 ,
Mass Spectrograph [3] - slide 2 ,

Membrane Inlet Systems: **Single membrane interface [4]** - slide 3 ,
Multimembrane interface [5] - slide 4 .

Main Instrument Parameters and Characteristics:

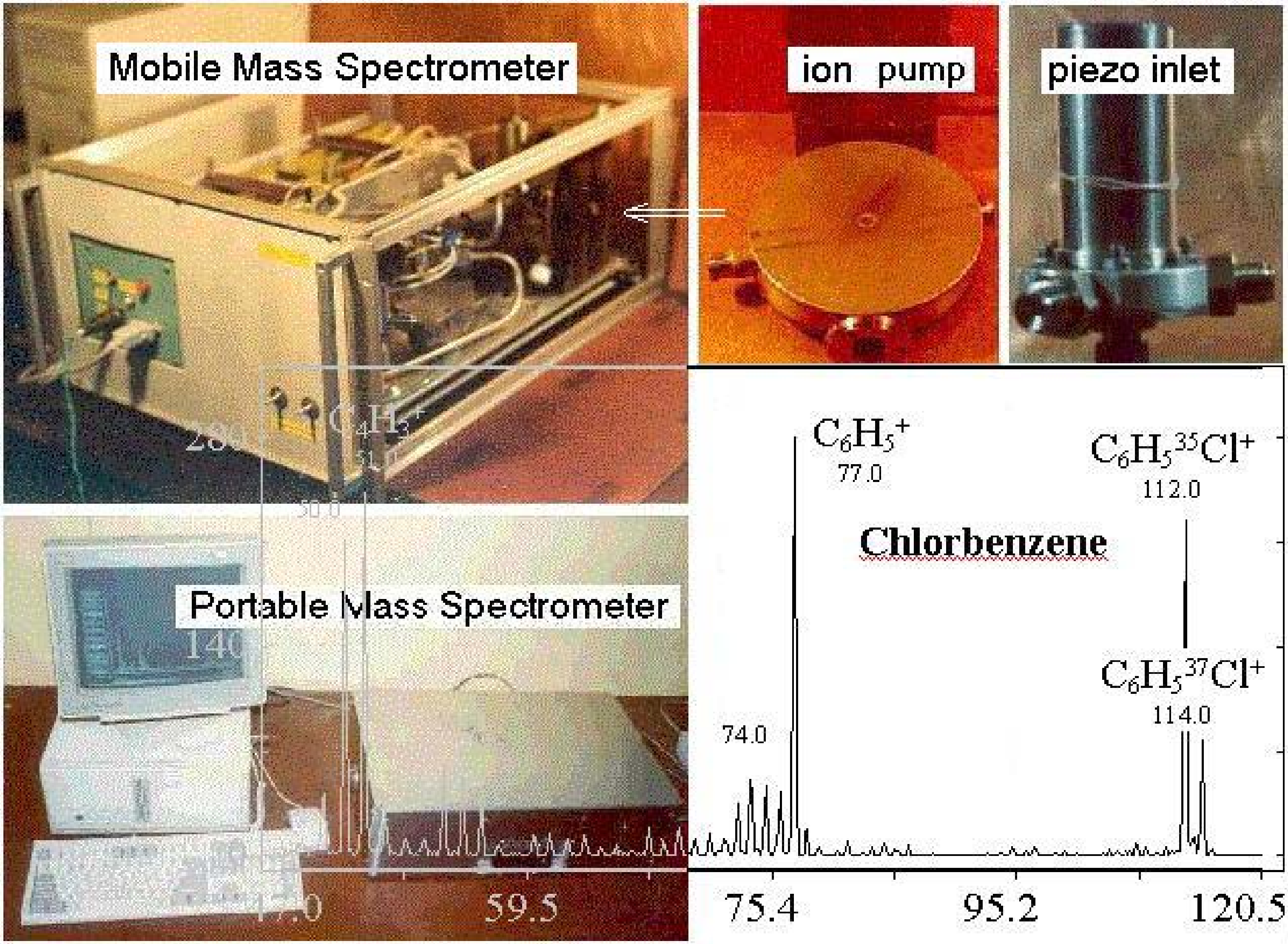
Sensitivity of MS with direct inlet
in air ....1 ppм÷100 ppm ,
Sensitivity of MS with membrane inlet **(for volatile organic compounds)**
in air..0.01 ppм÷10ppm ,
in water ....0.01 ppм÷10ppm ,
weight of the instrument **(with high vacuum pump)**.........................<20 kg,
overall dimensions...$230x370x500 mm^3$,
consumption...25W.

References:

[1] V.T.Kogan et.al., FACT(1997), **1**(6), 331.
[2] V.T.Kogan et.al., Instruments and Experimental Techniques (1999),**42**(4),569.
[3] V.T.Kogan et.al., Tech. Phys.(2001), **46**(4),492.
[4] V.T.Kogan et.al., Instruments and Experimental Techniques (2001),**44**(1),107.
[5] V.T.Kogan, O.S.Viktorova, Technical Physics Letters(2001), **27**(12), 984.

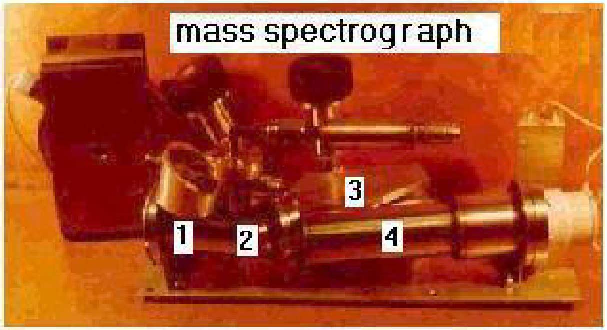
Some Options of MS Application

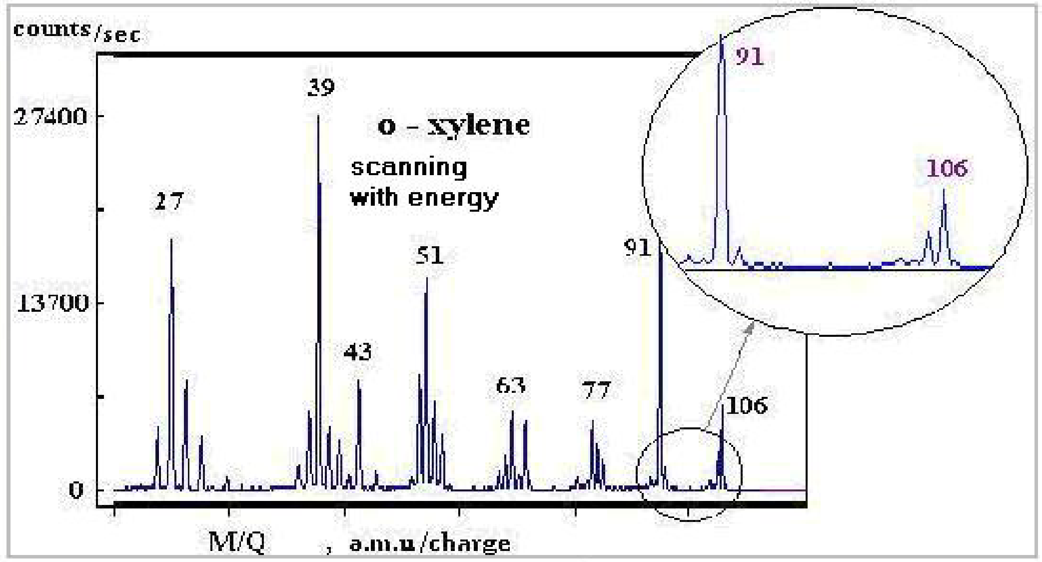
- ecological monitoring of air and aqueous pollutants: benzene, toluene, xylenes, trichloroethylene, tetrachloroethylene, 1,2-dichloroethane, dichlorobenzene, chlorobenzene, 1-propanol, 1- butanol, acetone, phenols and other compounds ;
- technological drilling control of gas/oil-well processes: methane, ethane, propane, butane, pentane, hexane, and sulfhydride.

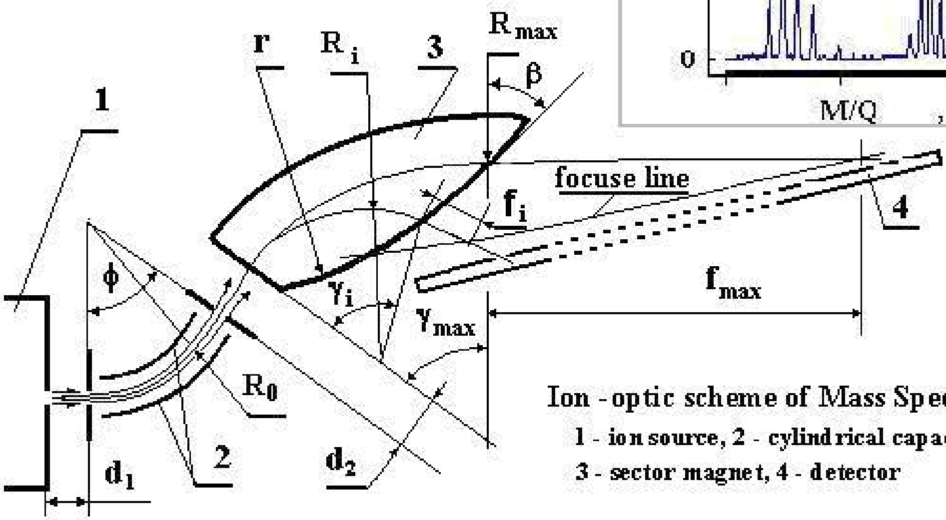


Mobile Mass Spectrometer
ion pump
piezo inlet
Portable Mass Spectrometer
$C_6H_5^+$
77.0
Chlorbenzene
$C_6H_5{}^{35}Cl^+$
112.0
$C_6H_5{}^{37}Cl^+$
114.0
74.0
59.5
75.4
95.2
120.5

Slide 1.







Ion-optic scheme of Mass Spectrograph

1 - ion source, 2 - cylindrical capacitor,

3 - sector magnet, 4 - detector

R_{max}, γ_{max} - the radius and sector angle of a trajectory of the maximum mass number ions within magnet system,

R_0 and **Φ** - the mean radius and the sector angle of a cylindrical capacitor,

r - the radius of curvature for a magnet exit boundary,

d_1 - the distance from the ion source to the electrostatic capacitor,

d_2 - the distance from the capacitor to the magnet.

$\pi/3 \geq \gamma_{max} \geq \pi/4$,

$(R_{max}^2/R_0)\mathrm{tg}(3\gamma_{max}/2) \geq r \geq R_{max}$,

$R_{max}/3 \geq d_1 \geq 0$,

$R_{max}/2 \geq d_2 \geq 0$,

$\gamma_{max}/2+\pi/8 \geq \Phi \geq \gamma_{max}/2+\pi/8-\pi/18$

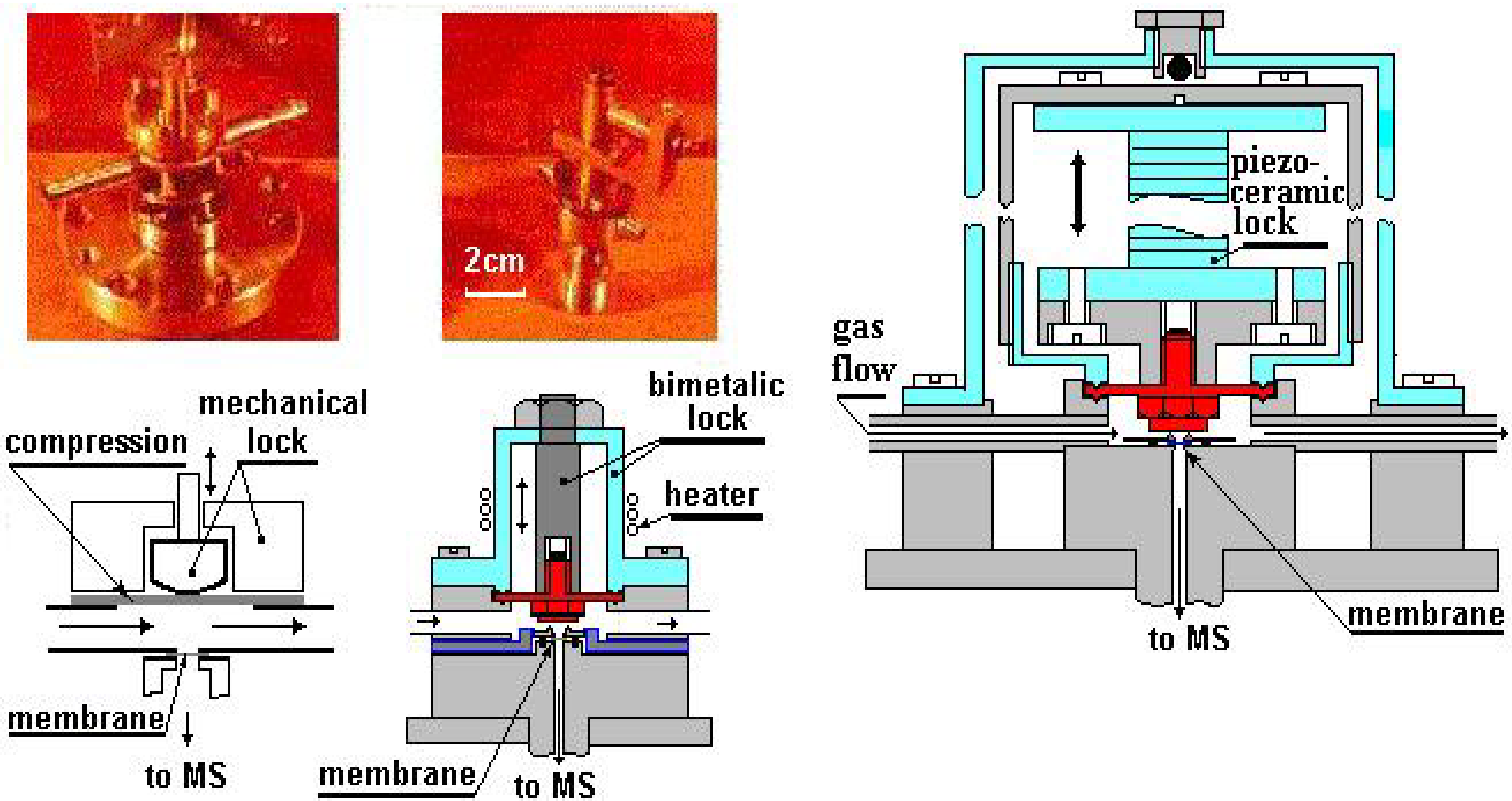
d_1=18 mm, d_2= 21 mm, R_0=125 mm, Φ = 42^0, γ_{max} = 52^0, R_{max} = 90 mm, r = 90 mm.

The resolving power of the instrument

134 on a 3% level.

Slide 2.

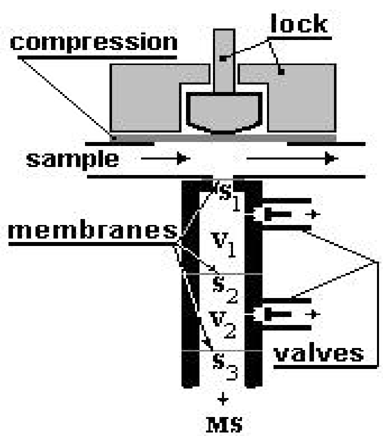
membrane inlets with different lock systems



a. mechanical b. bimetalic c. piezoceramic

Slide 3.

Schematic design



multi(N)membrane inlet system

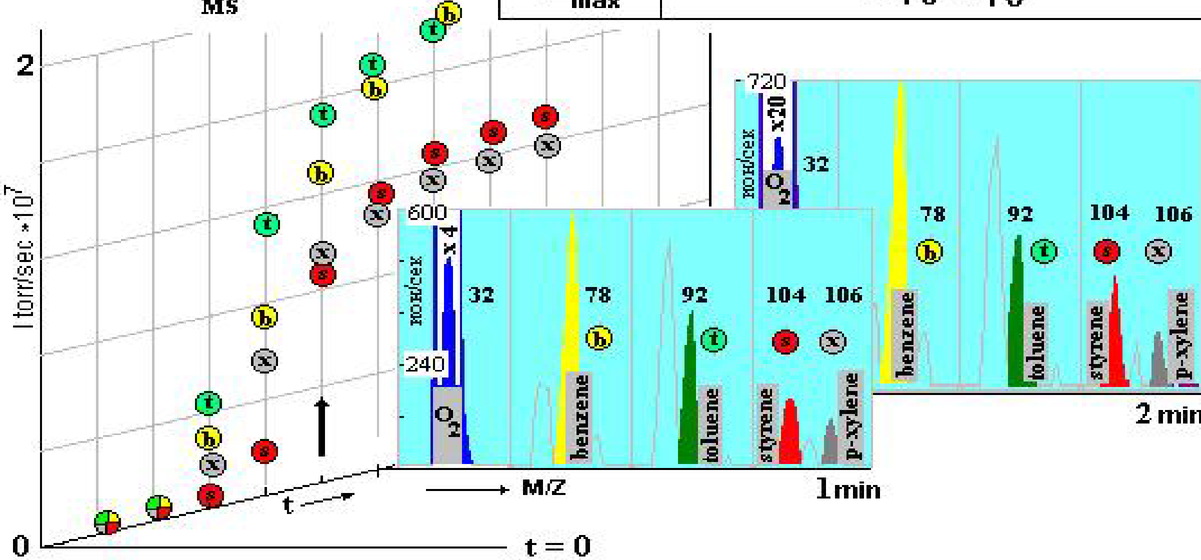
calculated maximum enrichment effect $E_{max} \simeq (k_j / k_m)^N$

k - permeability constant, j - compound, m- matrix

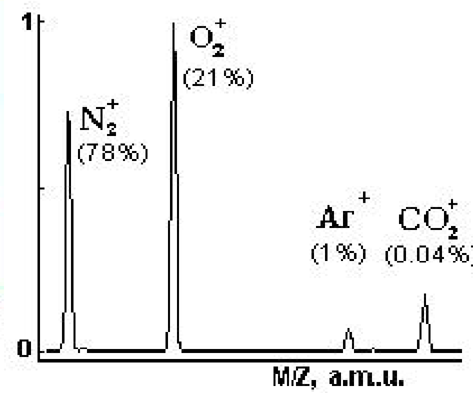
experimental results

N=3, membrane: dimethyl(poly)siloxane, 30 μm ; matrix: **nitrogen**

	VOCs				air constituents			
j	benzene	toluene	styrene	p-xylene	CO_2	Ar	O_2	N_2
E(t=45s)	$0.6(3)\times10^5$	$0.7(5)\times10^5$	$0.4(3)\times10^5$	$0.5(8)\times10^5$	650	13	7	1
E_{max}	$\simeq 10^6 - 10^7$				700	13	7	1



The response of the 3-membrane inlet system for benzene (3ppm), toluene (2.5ppm), styrene (1.5ppm) and p-xylene (1.5ppm) admixtures in 95% nitrogen + 5% oxygen



A fragment of mass spectrum of air, N=3

(There are initial concentration in brackets)

Slide 4.