



Beijing Energy Saving and Environmental Protection Exhibition (BIESEP) 2007

**Beijing
from 10th to 13th of June 2007**

**Strategies for Systematic Reduction of Water Losses in Existing
Water-Supply Networks**

**Dipl.-Ing. H. –J. Werner,
Hydro-Ingenieure GmbH, Düsseldorf
Germany**

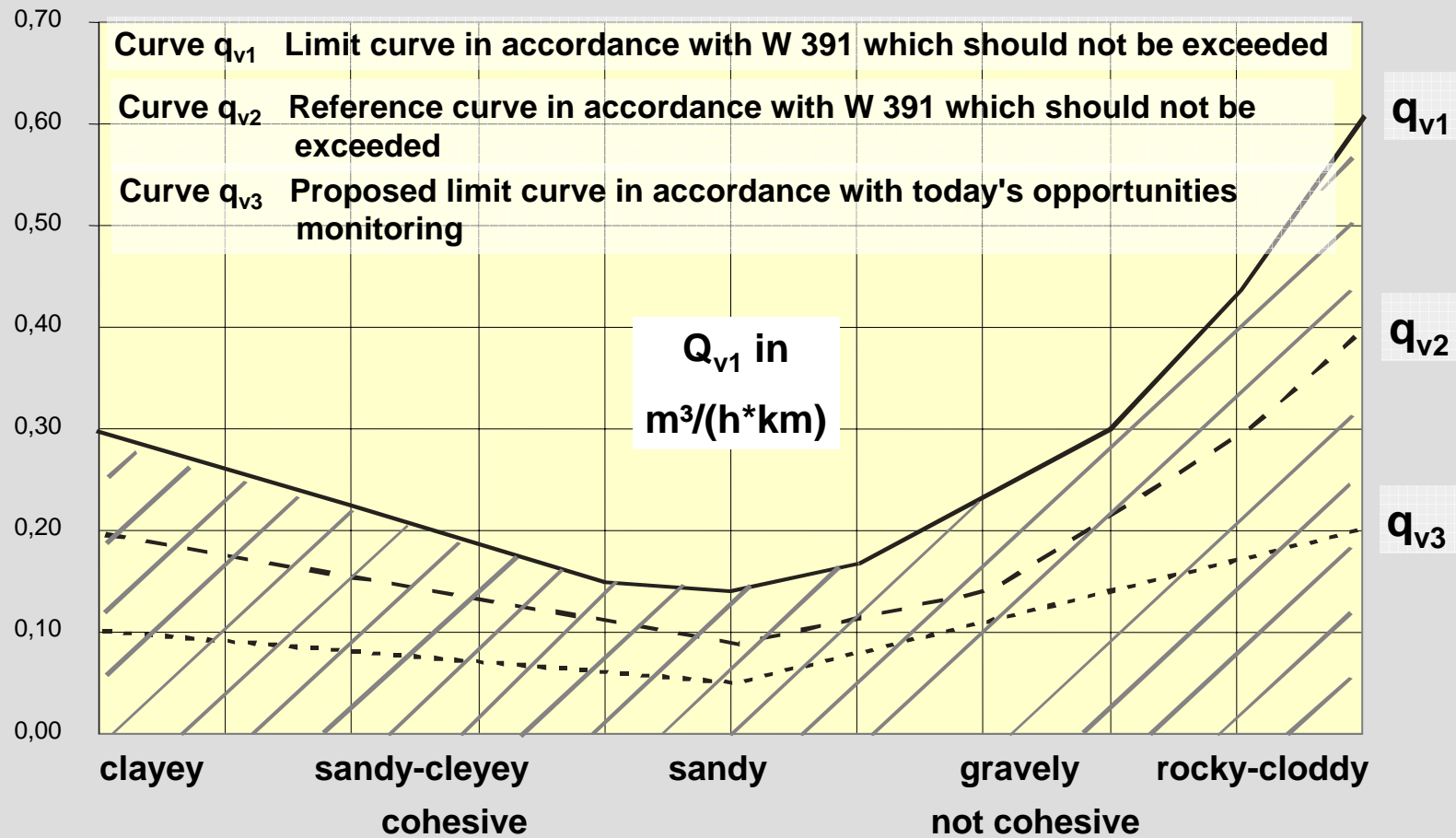
Reasons and Influencing Factors for Water Losses

generally applies:

bad condition of the network = serious water losses

- **kind of soil**
- **density of connections**
- **pipe material**
- **age of pipe**
- **condition of the outer insulation**
- **quality of pipe connections**
- **method of pipe laying**
- **areas with threat of corrosion by direct current (Railways etc.)**
- **works of third parties (i.e. construction works)**

Characteristic values for the specific water loss as a function of the predominating type of ground/soil



Selection of the Method for Water Loss reduction

(a) acoustic leakage detection on the entire network ?

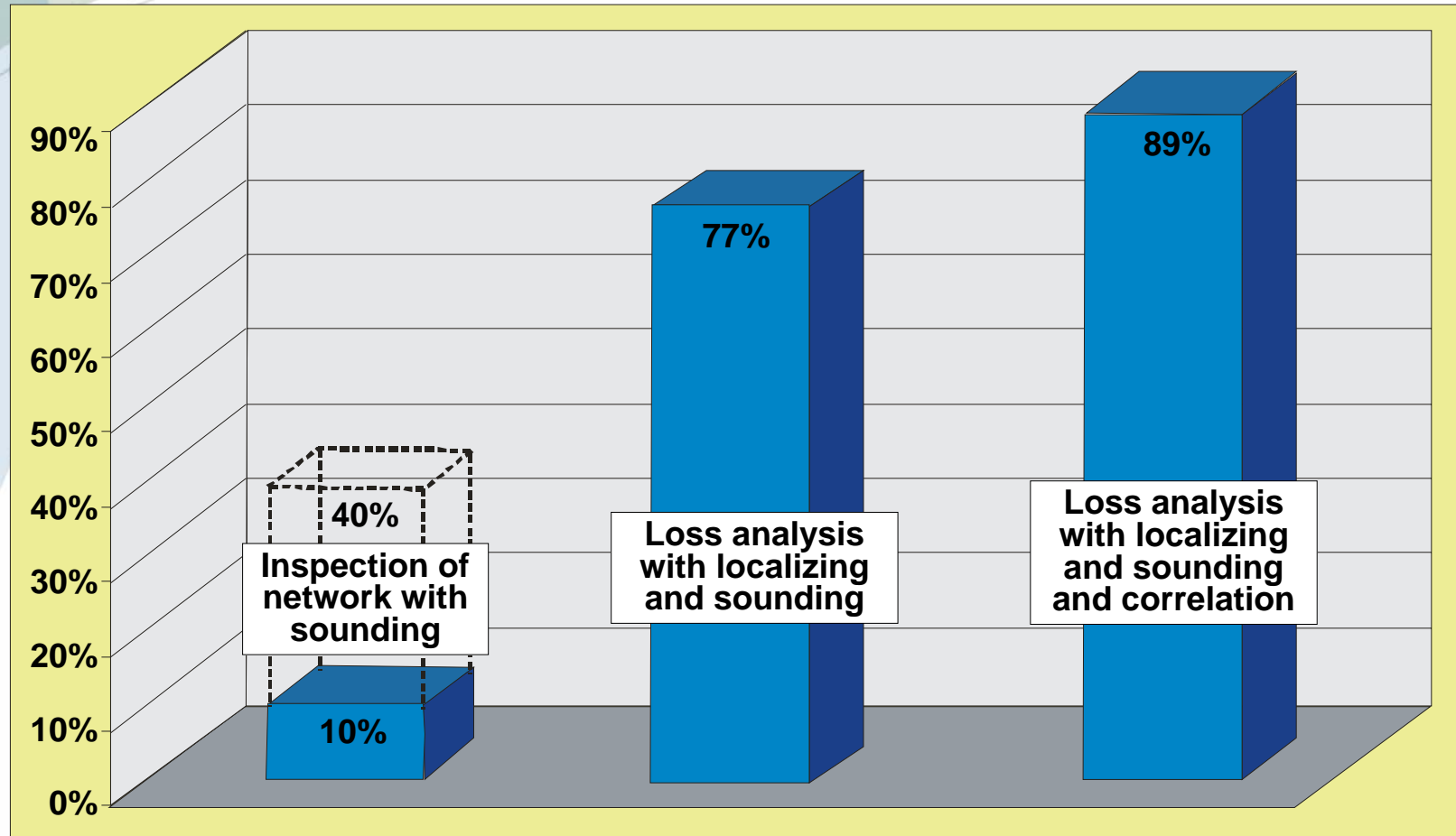
Cost-effective related to km pipe length investigated

or

(b) Loss analysis followed by acoustic leakage detection?

High cost related to km pipe length investigated

Success quota achievable with combined application of loss measuring and locating processes



Selection of the Method for Water Loss Reduction

answer:

(b)

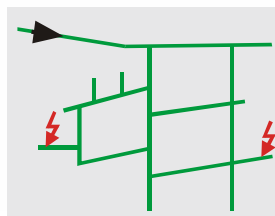
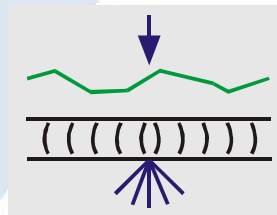
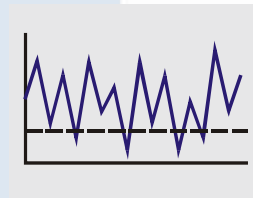
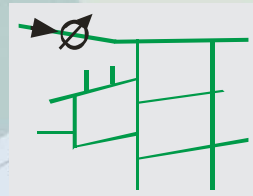
Raisin Principle:

Not looking for a needle in a haystack

but

Picking the raisins from the cake

Sequence of a Modern Leakage Detection



Water loss
or
Inflow analysis

Low consumption
measurement at
night

Measurement of
tightness

Loss quantity
in m^3/h

Result

Correlation-
measurement
device

listening devices
geophone,
microphone

Leakage Detection

number and
location
Of
leak points

Result

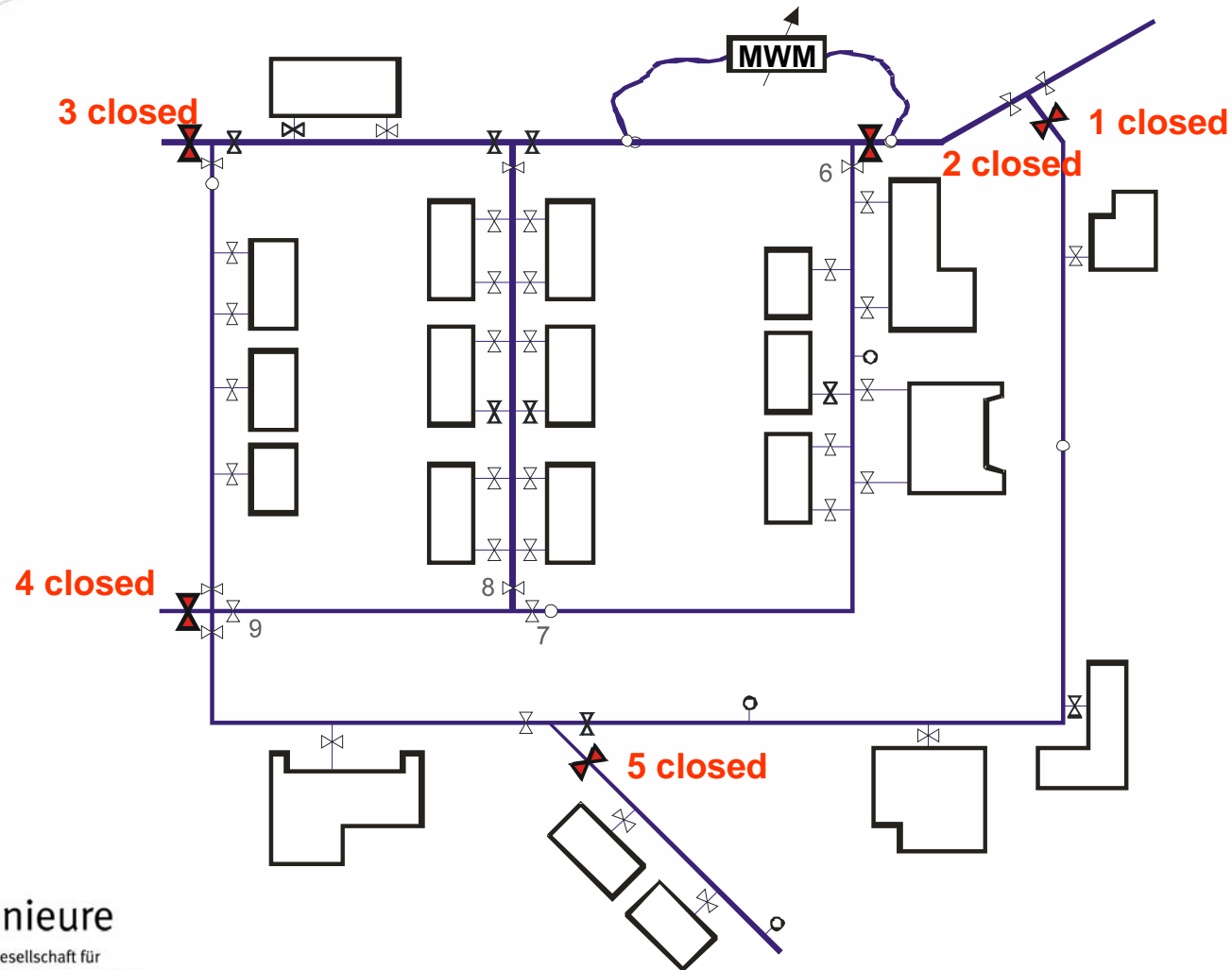
Water Loss Analysis

- **Derivation from a water quantity balance (usually annual quantity balance)**
- **Derivation from daily feeding (usually Sunday's quantity)**
- **Determination from hourly feeding (low consumption measurement at night)**
- **Measurement of „Zero“-Consumption (momentary-measurement)**

Devision of the Network into Sectors (i.e. by aid of a GIS)



Supply of a closed network sectors by a measuring bridge
(hydrant - hose – measuring device - hose - hydrant)



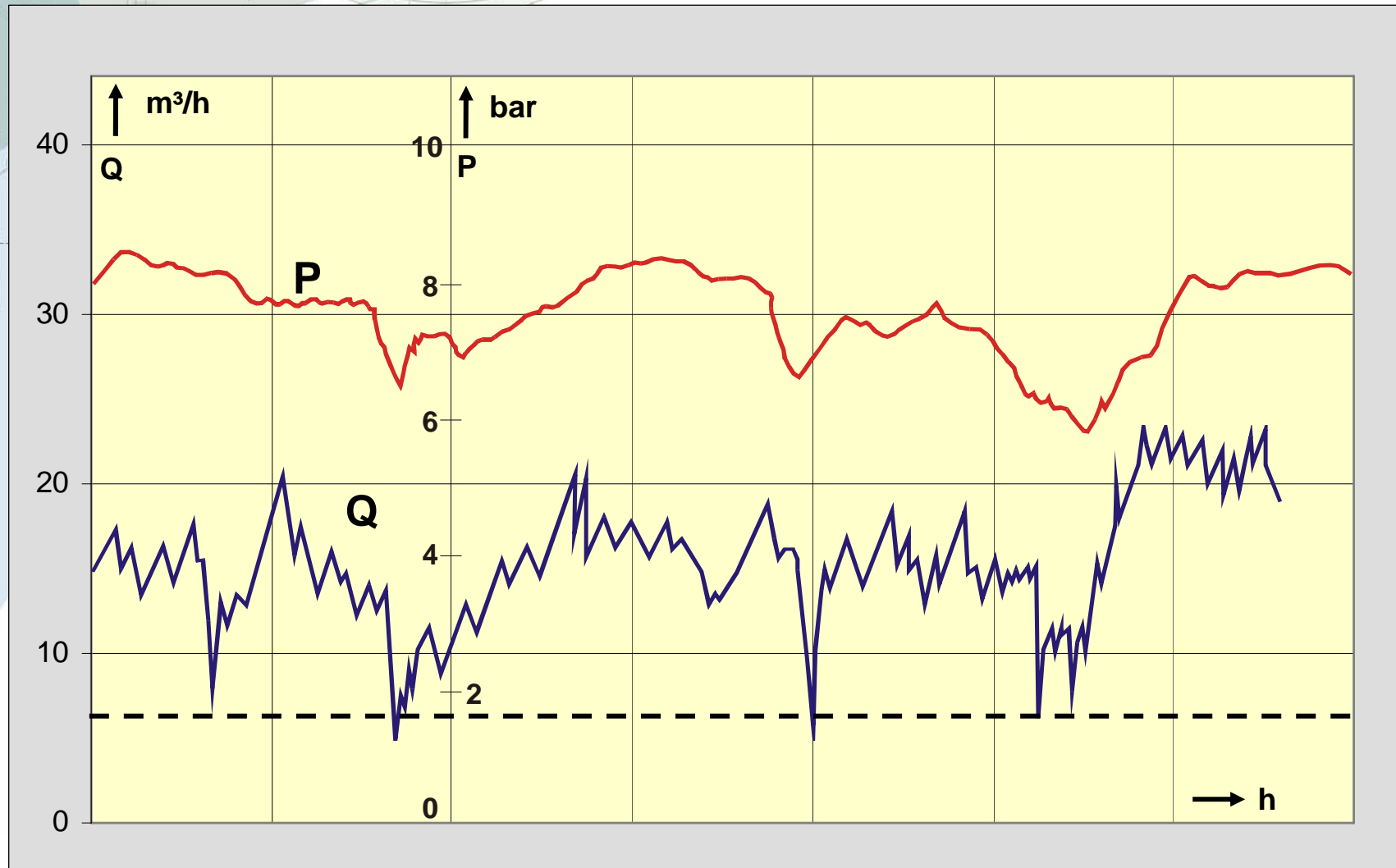
BIESEP 2007

Strategies of Systematic Reduction of Water Losses in Existing Water Supply Networks

Measuring Trailer with Full Set of Equipment



Record of Flow Rate and Pressure in the Measuring Trailer

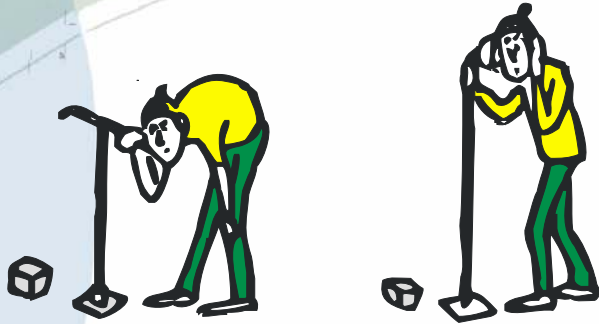


Section of a Loss Quantity Map generated by the aid of a GIS



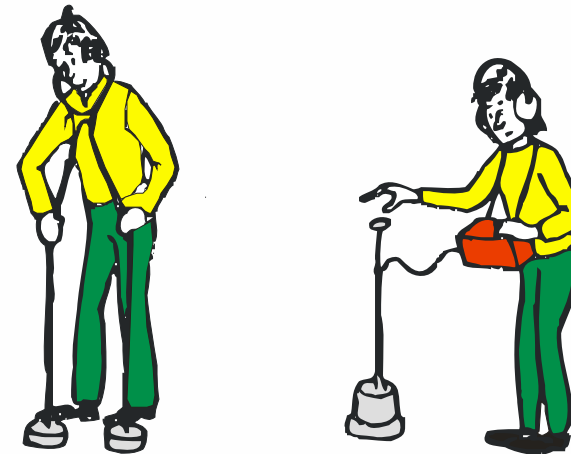
Acoustic Methods of Leakage Detection

direct listening



acoustic geophone

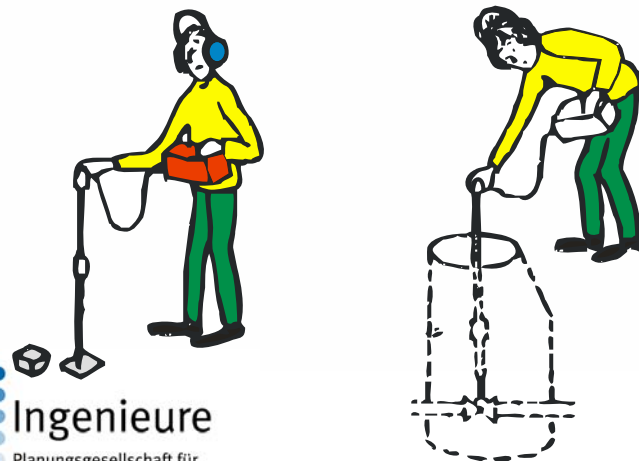
(amplification of the leak sounds by ground vibrations)



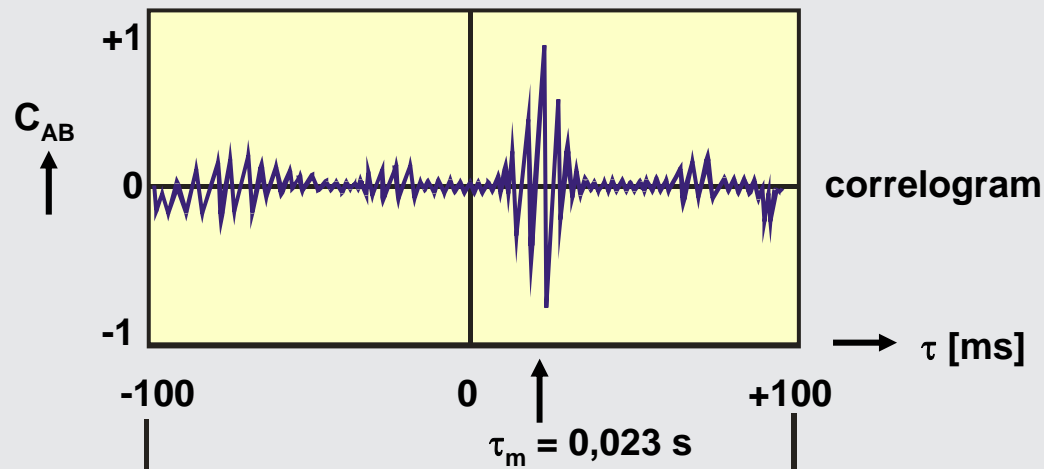
Electro acoustic listening

(amplification of leaksound by supply lines

Respectively armatures)



Locating of leaks by correlation measurement (shematic)



$$\Delta t = t_2 - t_1 = \tau_m$$

$$\Delta x = (L - x) - x = L - 2x$$

$$C_w = \Delta x / \Delta t = L - 2x / \tau_m$$

$$2x = L - C_w * \tau_m$$

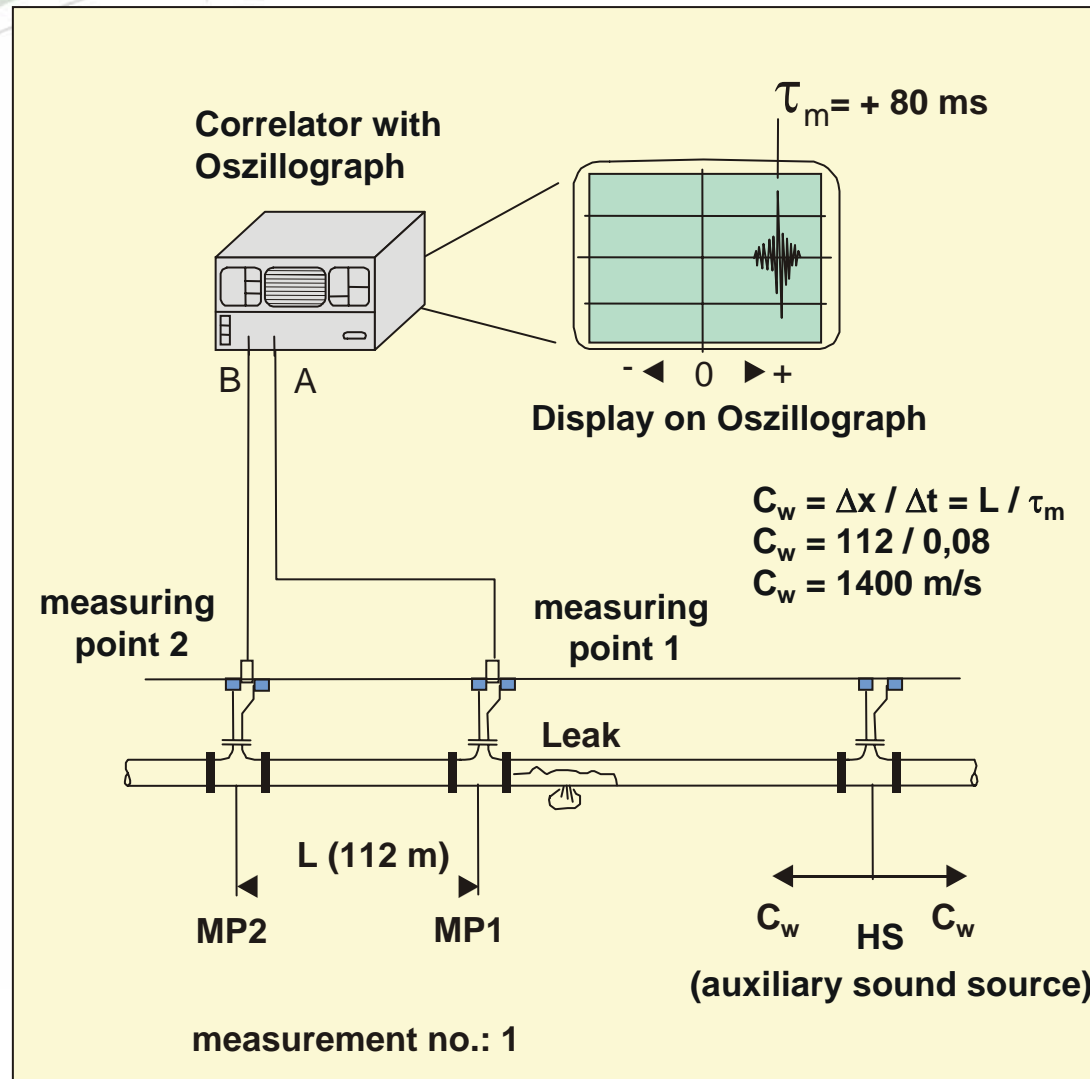
$$x = (L - C_w * \tau_m) / 2$$

$$2x = L - C_w * t_2 - t_1 = L - C_w * \tau_m$$

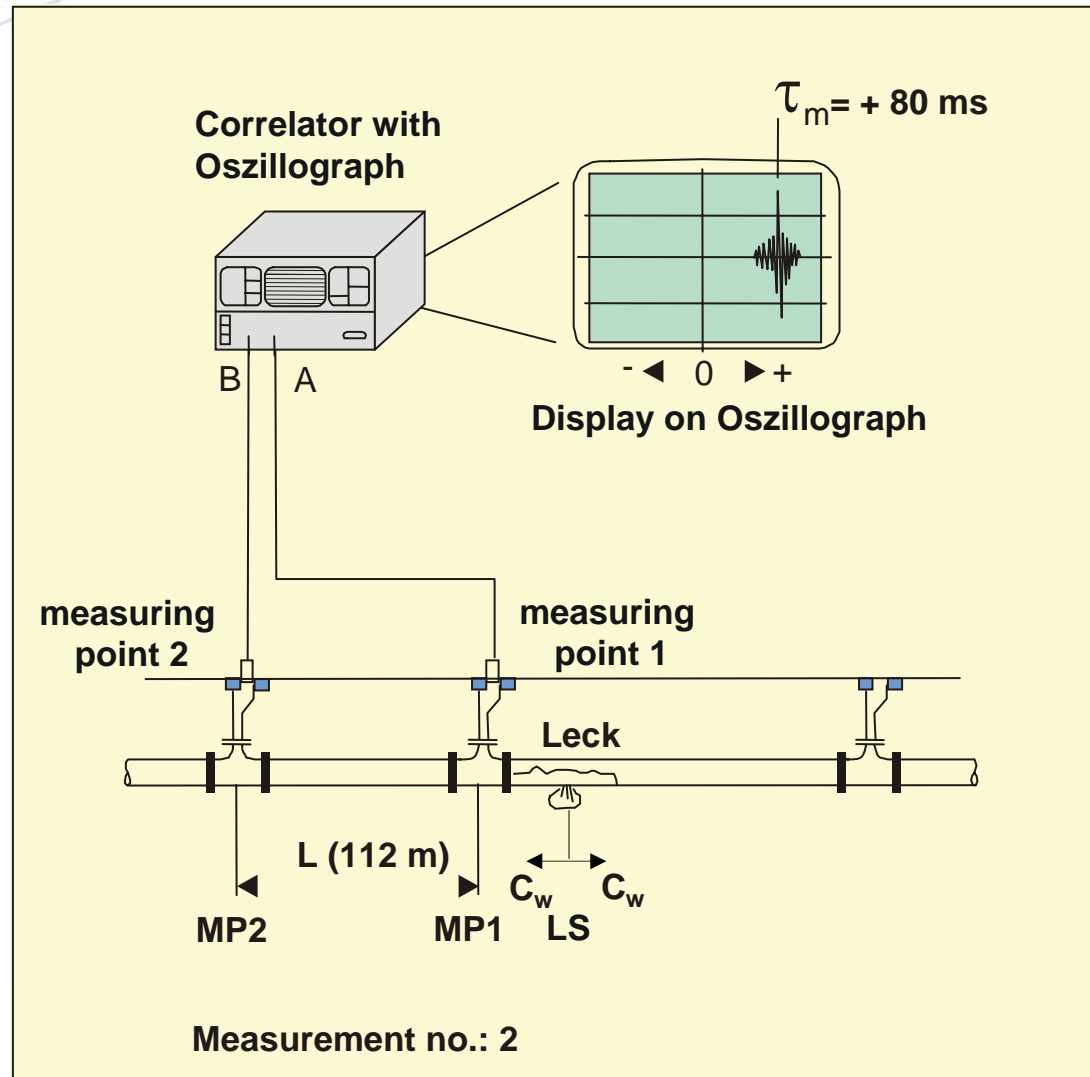
$$2x = 82,1\text{m} - 1240 \text{ m/s} * 0,023 \text{ s}$$

location: $x = 26,8\text{m}$ distance from MS 1

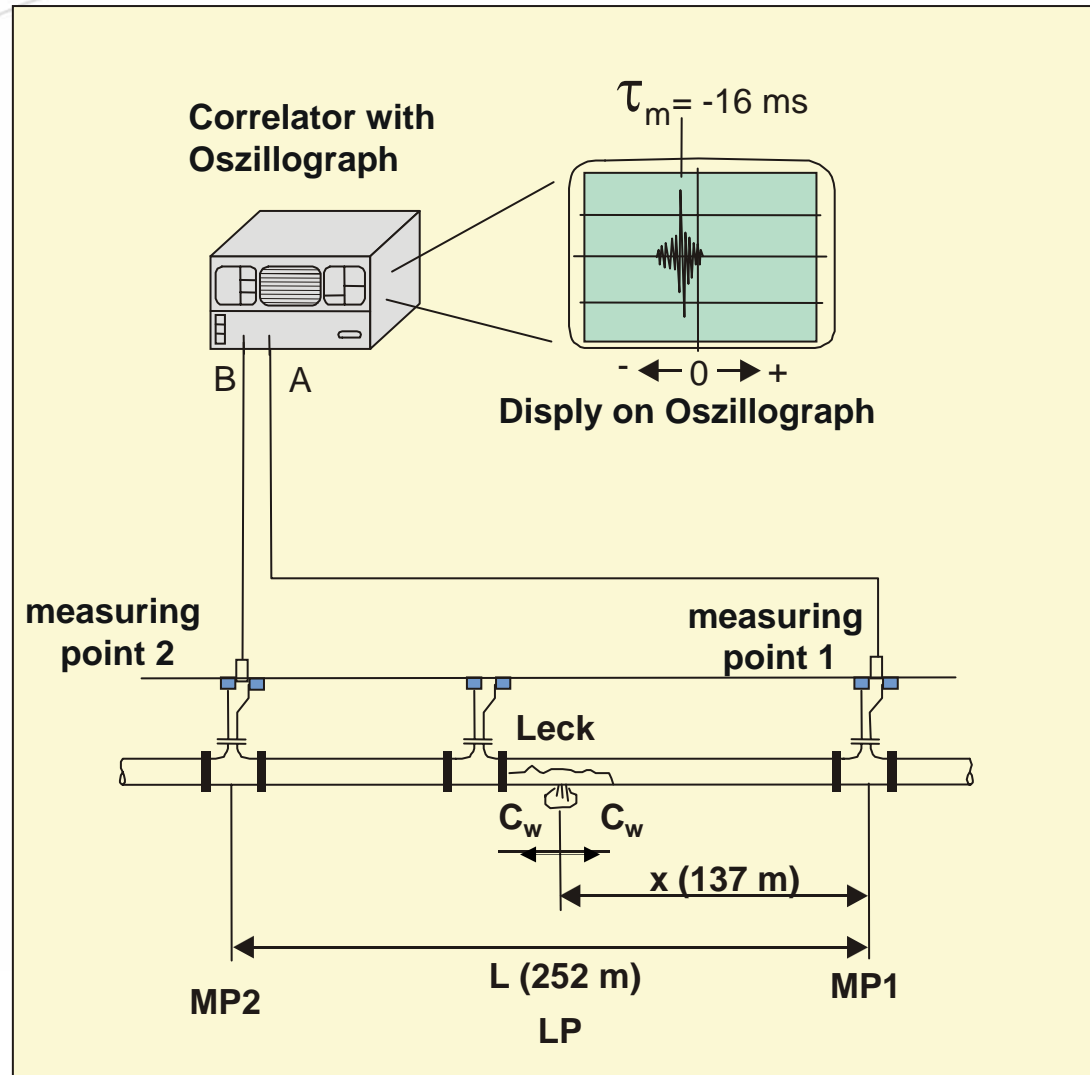
1st Measurement by using an auxiliary sound source



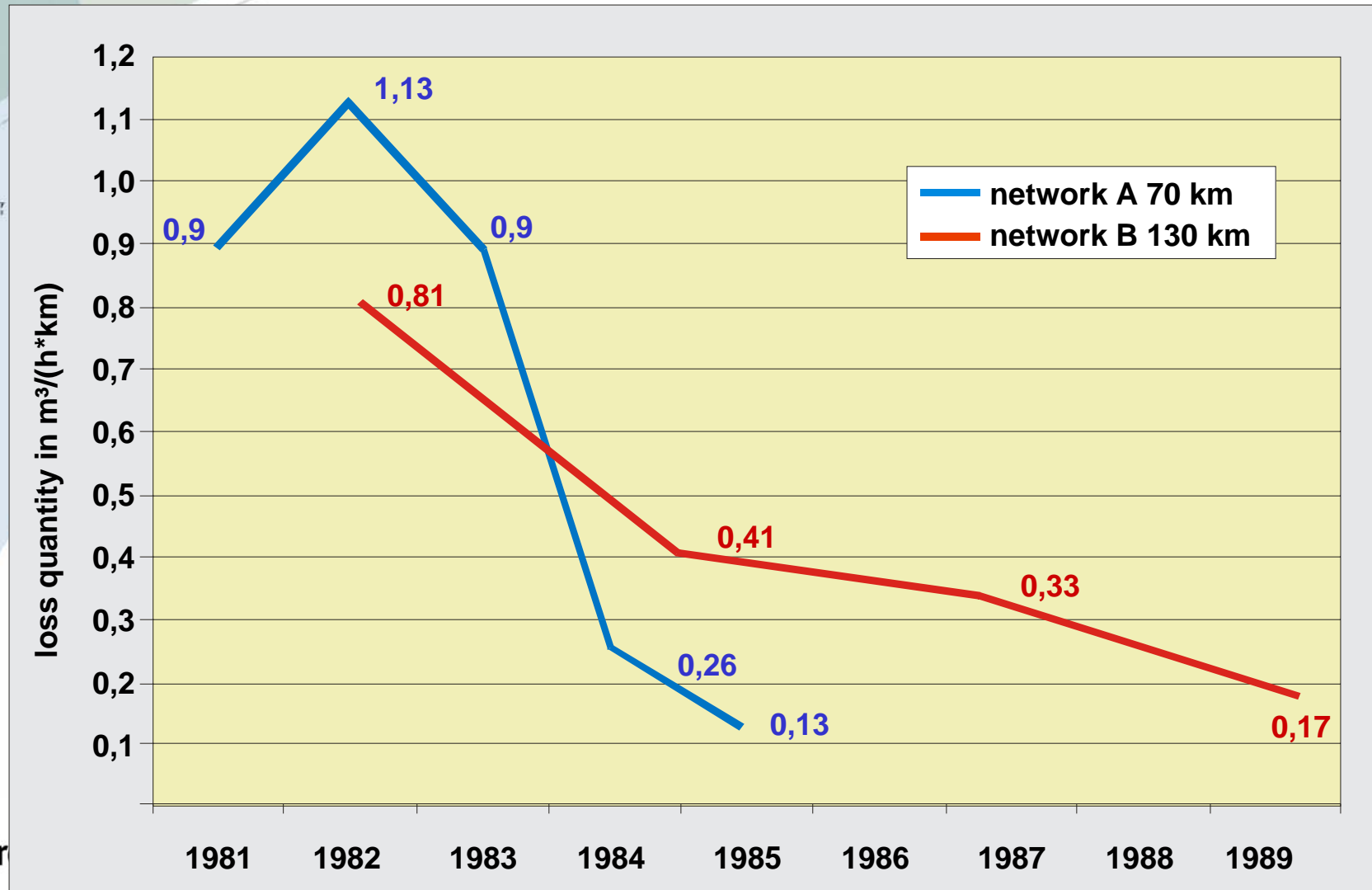
2nd Measurement by using an auxiliary sound source



3rd measurement with shifted MP1



Consistent Reduction of Water Losses in Two Leak Intensive Networks



Conclusion

- **It is not possible to avoid water losses completely**
- **The relevant losses have to be reduced**
- **Success can only be achieved by use of systematic methods**
- **Limits of the methods depend on the exactness of the measuring devices**
- **Sustainable success only by consistent and continuous O&M**
- **Water loss reduction is a long term process**



BIESEP 2007

Strategies of Systematic Reduction of Water Losses in Existing Water Supply Networks

**THANK YOU VERY MUCH
FOR YOUR
ATTENTION!**