

## **History and today practice \* in sclerosant foam preparation**

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Wiesbaden, Germany**

**\* and current knowledge about  
foam qualities / properties**



## **How sclerotherapy started...**

<b>Elsholz (1623-1688)</b>	<b>first injection into human</b>
<b>Zollikofer 1682</b>	<b>first injection to sclerose</b>
<b>Pravaz (1791-1853)</b>	<b>first graduated syringe</b>
<b>Tavel 1904</b>	<b>ferric chlorid injection</b>
<b>Paul Linser 1911</b>	<b>sublimate injection</b>
<b>Jean Sicard 1916</b>	<b>sublimate injection</b>
<b>Higgins, Kittel 1930</b>	<b>sodium morrhuate</b>
<b>Biegeleisen 1937</b>	<b>ethanolamin oleate</b>
<b>Reiner 1946</b>	<b>sodium tetradecyl sulphate</b>
<b>Henschel 1963</b>	<b>polidocanol</b>
<b>Barber 1974</b>	<b>Duplex</b>
<b>Knight, Vin, Zygmunt 1989</b>	<b>Duplex-guided sclerotherapy</b>
<b>Schadeck 1993</b>	<b>sclerosants for Duplex contrast</b>



## Sclerosant agents

### osmotic

**Sodium-Cl**  
**Sodium-Salicylate**  
**Saccharose**  
**Dextrose**  
**Glucose**  
**Phenol**  
**...**

### corrosive

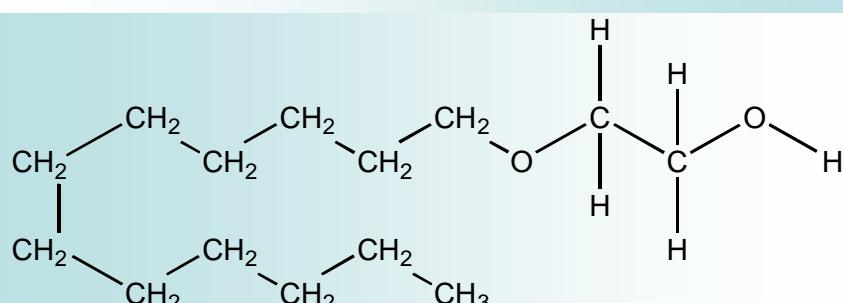
**Iod-Iodine**  
**Chromated glycerin**  
**...**

### detoxifiers

**Ethanolamine**  
**Sodium Morrhuat**  
**Sodium Tetradecyl-sulfate**  
**Polidocanol**



## History: Polidocanol



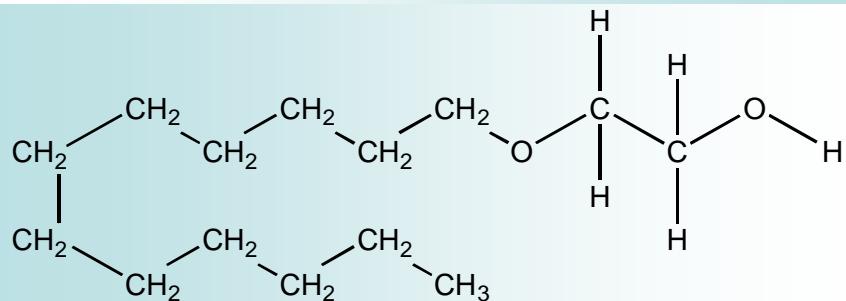
**topic local anesthetic**

**tried as injectable anesthetic**

**development to a sclerosant**



## History: Polidocanol



**polar structure**

**surfactant properties**

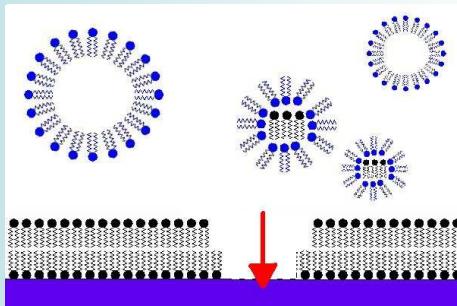
**forms micelles**



## Effects of liquid sclerosants



## Effects of Polidocanol

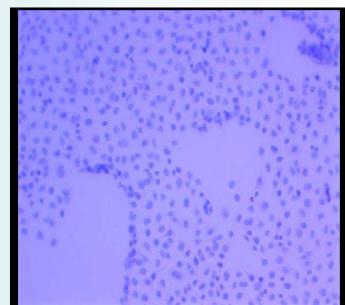
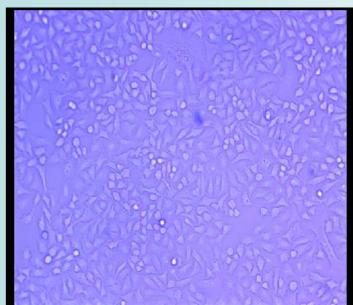


**damages endothelial cells  
in vitro: anti-coagulant effects  
denaturizes lipoproteins**



## Effects of Polidocanol

Wollmann JC. Schaum - zwischen Vergangenheit und Zukunft. 8. Bonner Venenstage 15. -16. Feb. 2002. Vasomed 2002;16(1):34-5.  
Hamel-Desnos C, Desnos P, Wollmann JC, Ouvry P, Mako S, Allaert FA. Evaluation of the Efficacy of Polidocanol in the Form of Foam Compared With Liquid Form in Sclerotherapy of the Greater Saphenous Vein: Initial Results. Dermatol Surg 2003;29(12):1170-6



## History: Foam techniques

Wollmann JC. The History of Sclerosing Foams. Dermatol Surg 2004;30:694-703.

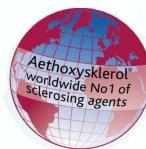
McAusland	1939	First use of froth (vial technique)
Orbach	1944	Airblock technique
Foote	1944	Syringe technique
Sigg	1949	Foamblock technique
Orbach	1950	Vasospasm after foam sclerotherapy
Ree	1953	First use of "pure" foam
Flückiger	1956	Retrograde injection, aspiration technique
Mayer and Brücke	1957	First microfoam, double-piston syringe
Flückiger	1962	Turbulent flow
Lukenheimer	1963	First use of polidocanol foam
Gillesberger	1969	Low-pressure technique
Hauer	1984	Twin syringe technique
Grigg	1986	Double syringes, connecting tube
J Cabrera-Garrido	1995	Rotating brush technique
Monfreux	1997	Low-pressure technique
Gaston and Orus	1998	Advanced low-pressure technique
Sadoun and Benigni	1998	Advanced low-pressure technique
Mingo	1999	High-pressure technique
Tessari	1999	Double Syringes, 3-way tap



## History: Foam techniques

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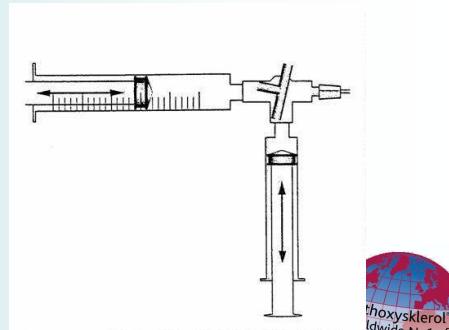
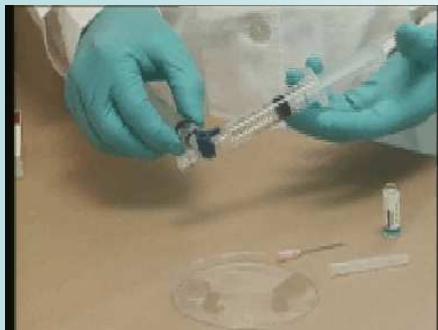
Tessari	1999	Double Syringes, 3-way tap
Frullini	2000	Turbulent flow
Magdiel	2000	High-pressure technique
BTG	2000	Single Foam Can, double-piston syringe
Wollmann	2001	Double Syringes, 2-way connector
Gachet	2001	Aspiration technique
Onorati	2001	Double-piston syringe
Hamel, Desnos	2001	TurboFoamer
Wollmann, Schliephake	2002	DSS II
Wollmann, Schliephake	2002	AE-Foamer
BTG	2003	improved Single Foam Can
J Cabrera-Garrido	2003	MicroFoam
BTG	2005	Double Foam Can
Cavezzi, Tessari, Cabrera	2005	Use of mixture of gases...
PentaFerte	2005	PentaMousse
Wollmann	2005	EasyFoam
Monfreux	2006	Sterivein



## History: Foam techniques

Wollmann JC. The History of Sclerosing Foams. Dermatol Surg 2004;30:694-703.

**Tessari  
1999**



## History: Foam techniques

Wollmann JC. The History of Sclerosant Foams - Persons, Techniques, Patents and Medical Improvements. In: Bergan JJ. The Foam Book. Royal Society of Medicine Press 2008

**DSS 2001**



## History: Foam techniques

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### EasyFoam 2005

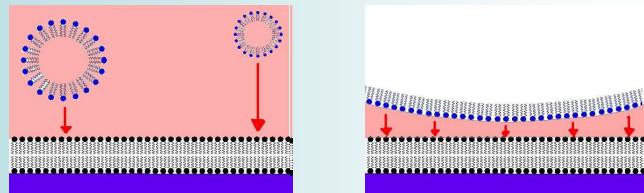


## Effects of Foam



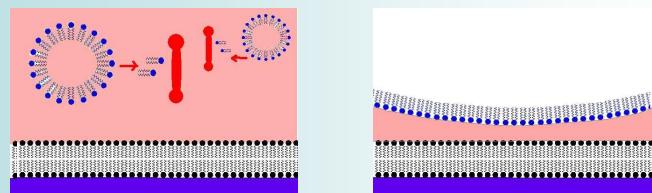
## Effects of Polidocanol-Foam

**higher effective concentration at endothelium compared to liquid**



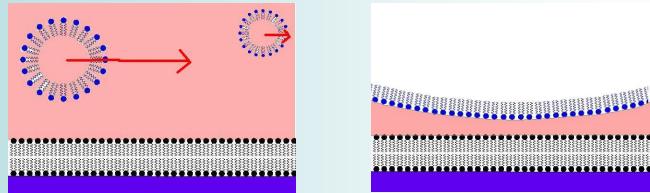
## Effects of Polidocanol-Foam

**lower dilution compared to liquid**



## Effects of Polidocanol-Foam

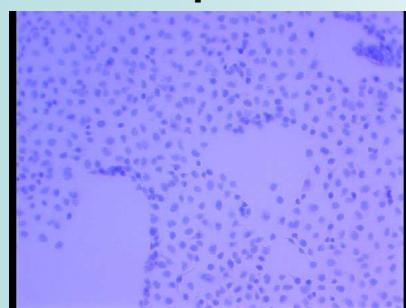
**longer contact time at endothelium compared to liquid**



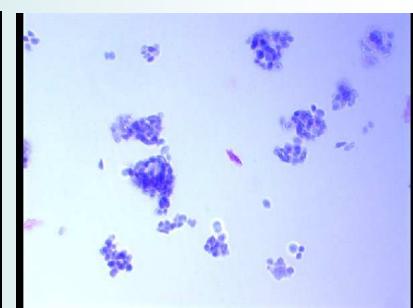
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liquid

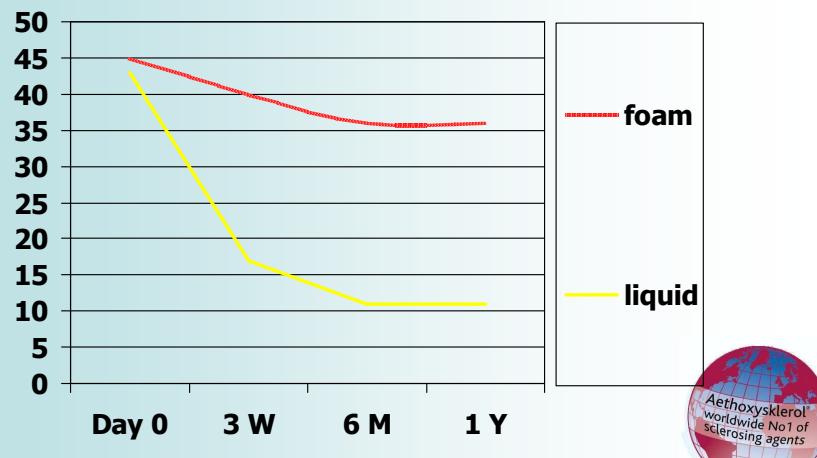


DSS-foam



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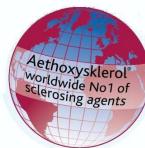
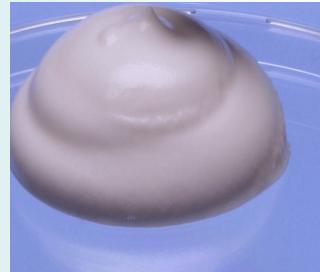


## Foam quality



## Different qualities of foam

Wollmann JC. An experimental model to pinpoint properties and behaviour of sclerosing foams. American College of Phlebology 17th Annual Congress, San Diego, California, August 27-31, 2003



## 1<sup>st</sup> Consensus Meeting on Foam Sclerotherapy Tegernsee 2003



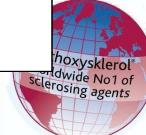
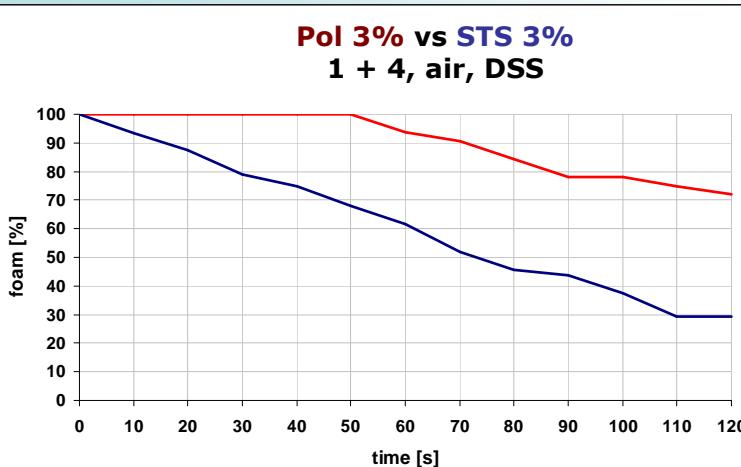
## Characteristics of foam

Sclerosant foam is characterized by

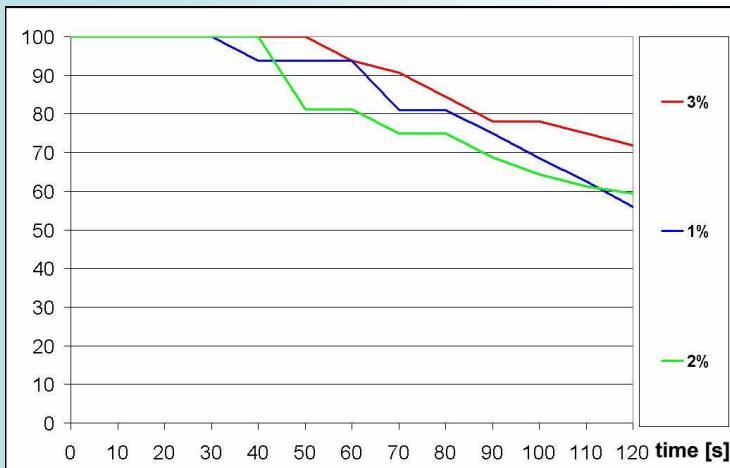
- type/concentration of sclerosant
- type of gas
- ratio of sclerosant + gas ( $x + y$ )  ~~$\rightarrow x=y$~~
- method of foam preparation
- time
- bubble size



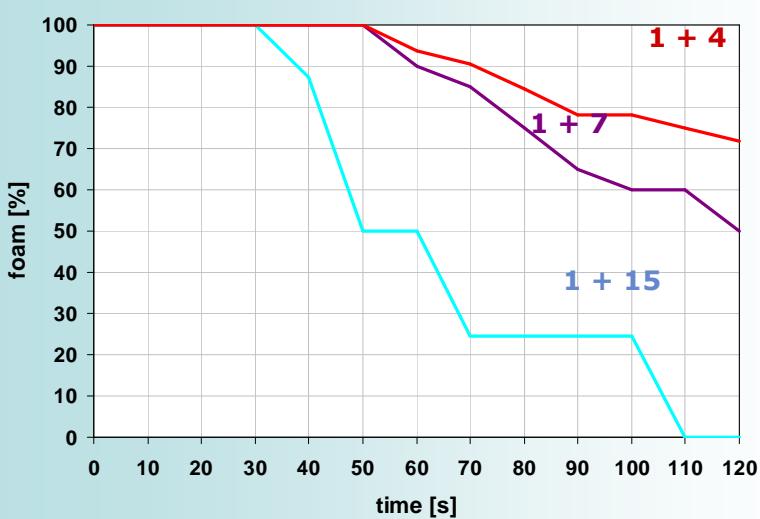
## Sclerosant



## Concentration

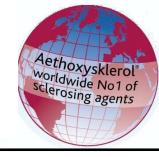
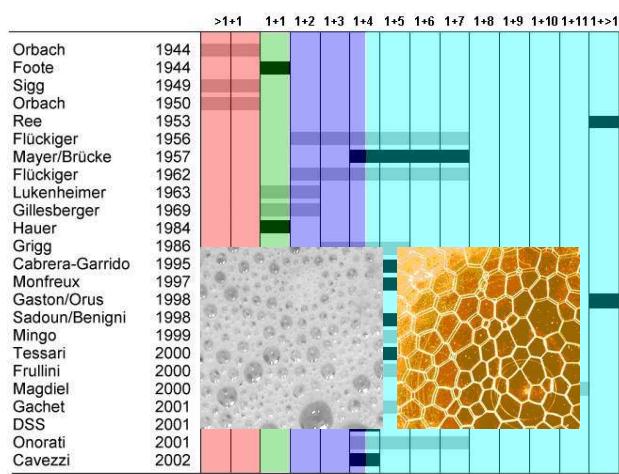


## Ratio of Liquid + Gas

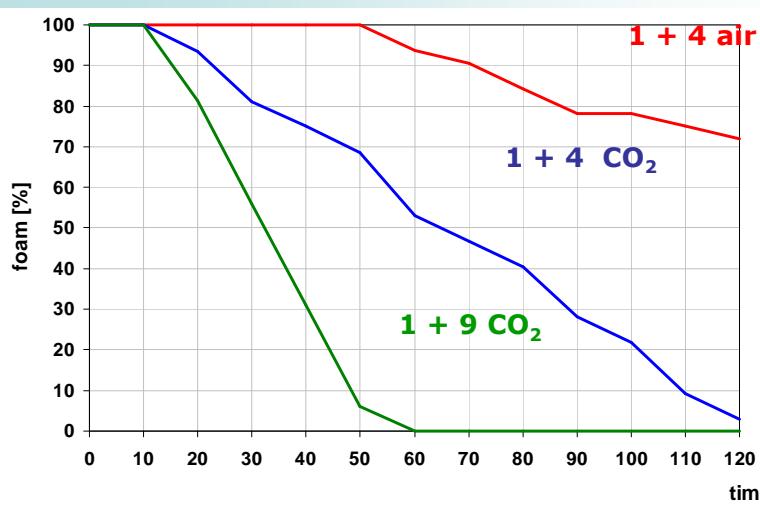


## Ratio of Liquid + Gas

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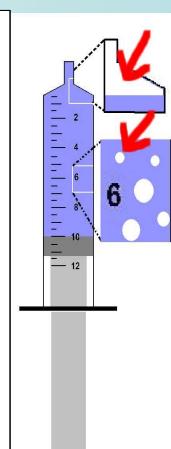
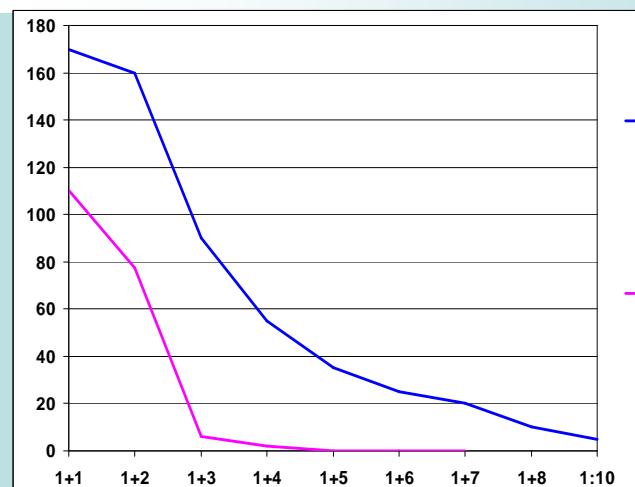
## Type of gas



## Method of preparation



## Macroscopic homogeneity



## **Anything else that influences foam aging?**

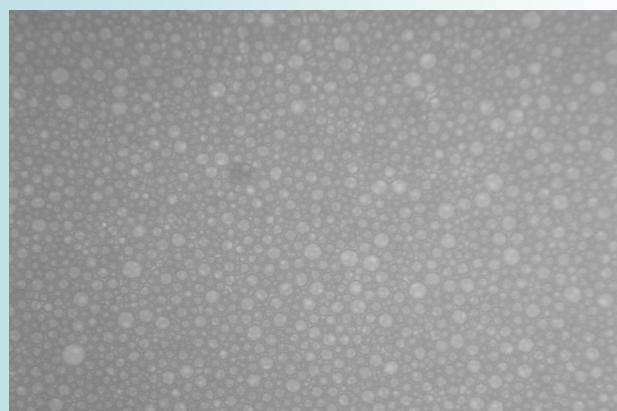
**kreussler**  
PHARMA

**answer: yes !!!**

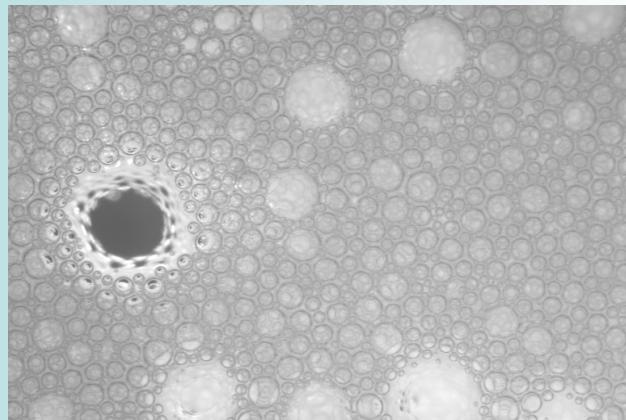


## **Ideal foam aging**

**kreussler**  
PHARMA



## Premature foam aging



## Problems with too little silicone

Onorati 2001



Wollmann JC. The History of Sclerosant Foams - Persons, Techniques, Patents and Medical Improvements. In: Bergan JJ. The Foam Book. Royal Society of Medicine Press 2008



## Foam - Standardization

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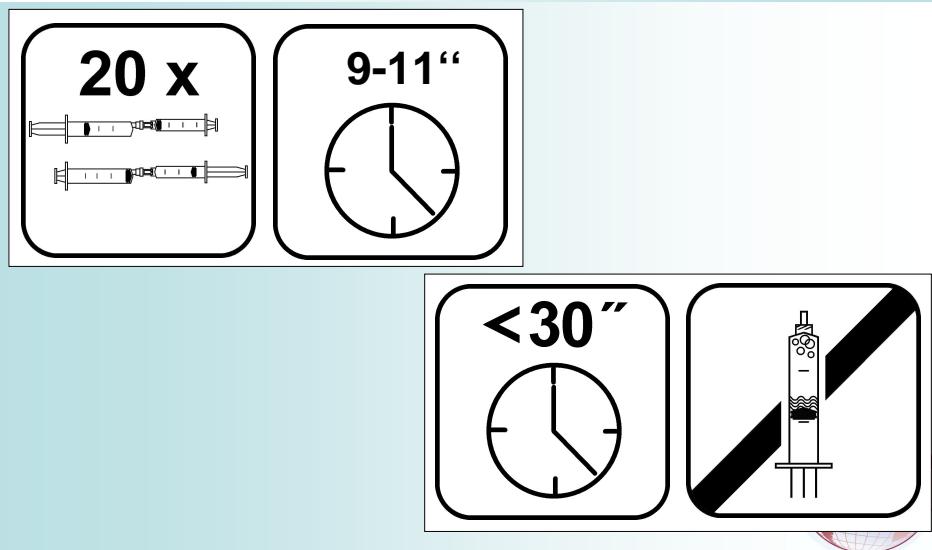


**Defined, sterile gas volume**  
**Defined, optimized ratio of 1 + 4,6**  
**Improved foam quality / properties**



## EasyFoam - Standardization

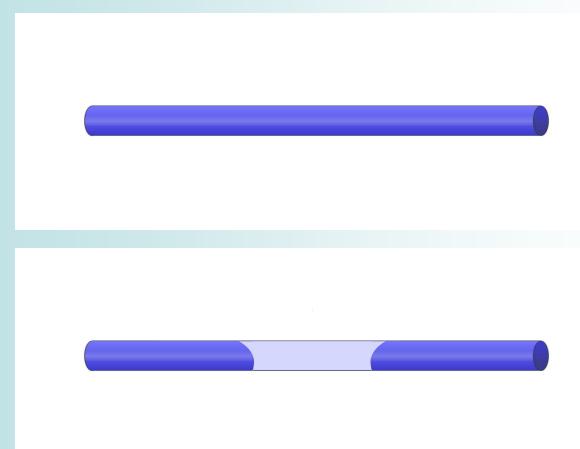
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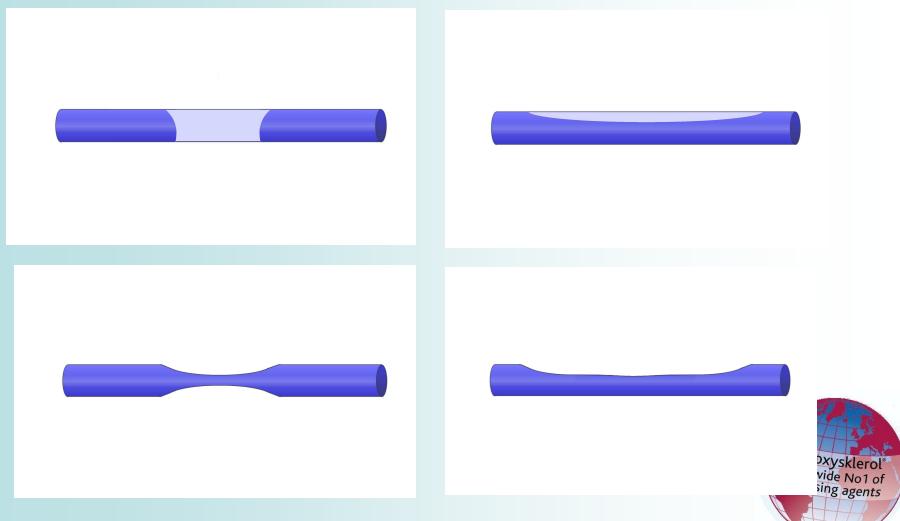
# Foam physics



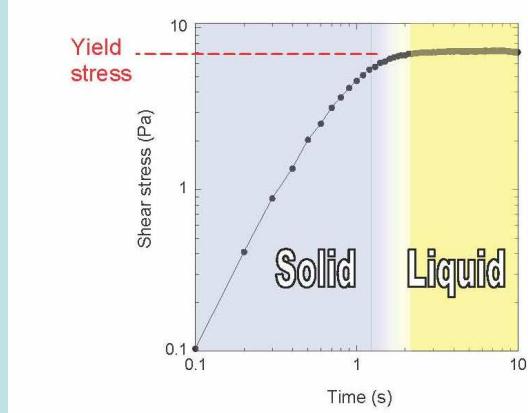
## Foam physics - displacement



## Foam physics - displacement



## Rheology



## Rheology

**Yield stress indicates a cross-over from solid-like to liquid-like mechanical behaviour of foam**

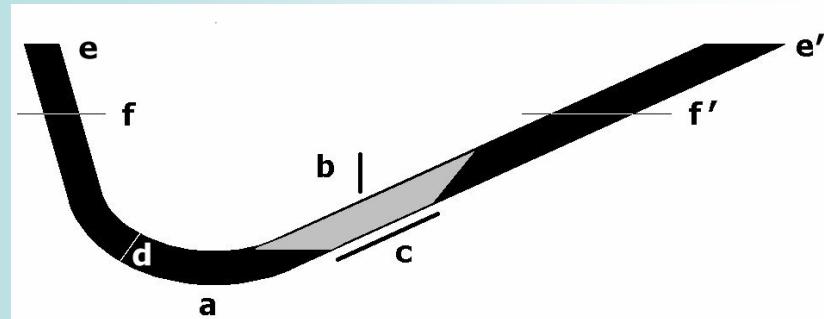
**resistance to stress is a parameter relevant for sclerotherapy**

**as the foam collapses, it loses its solid-like properties**

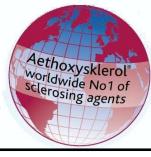
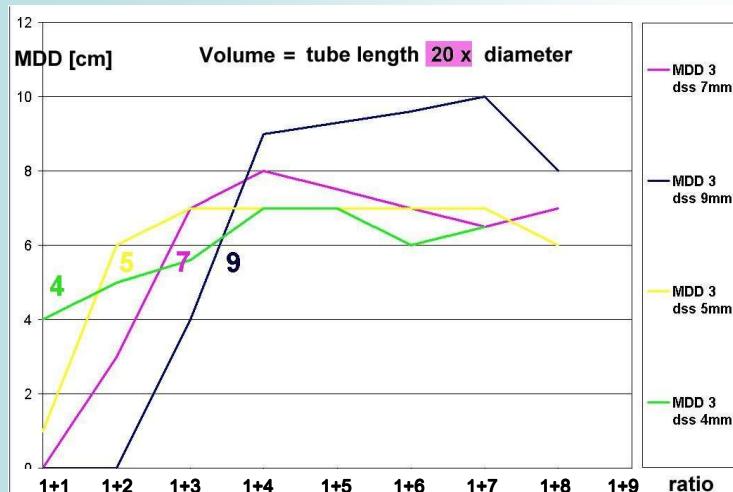
**maximum stress reached is a function of the foam age**



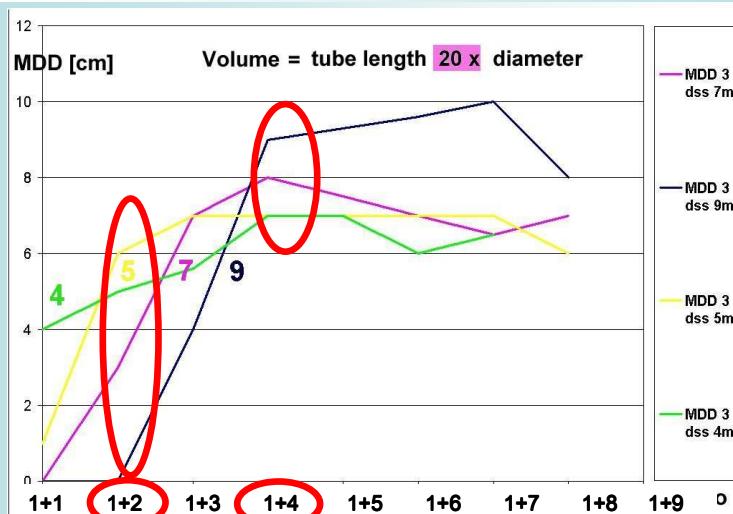
## Rheology - displacement



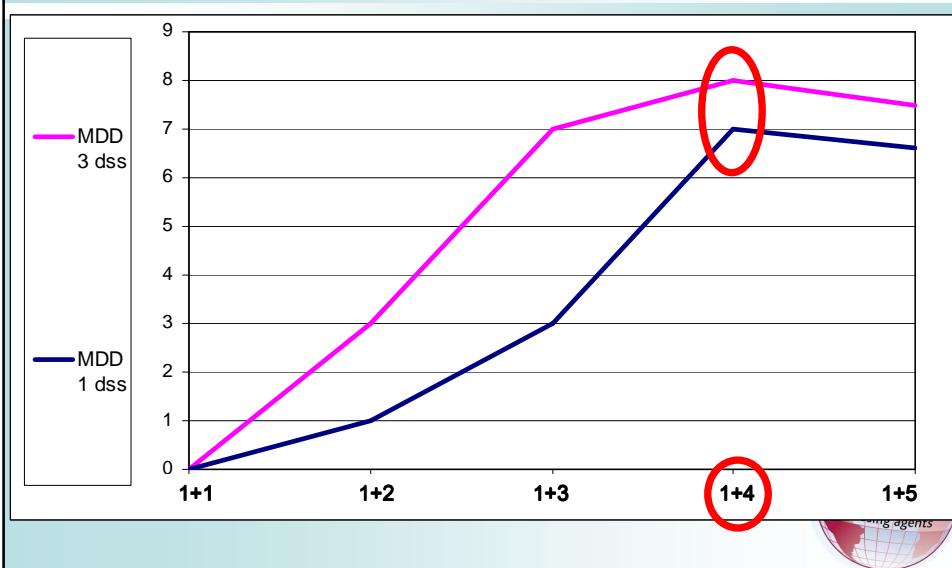
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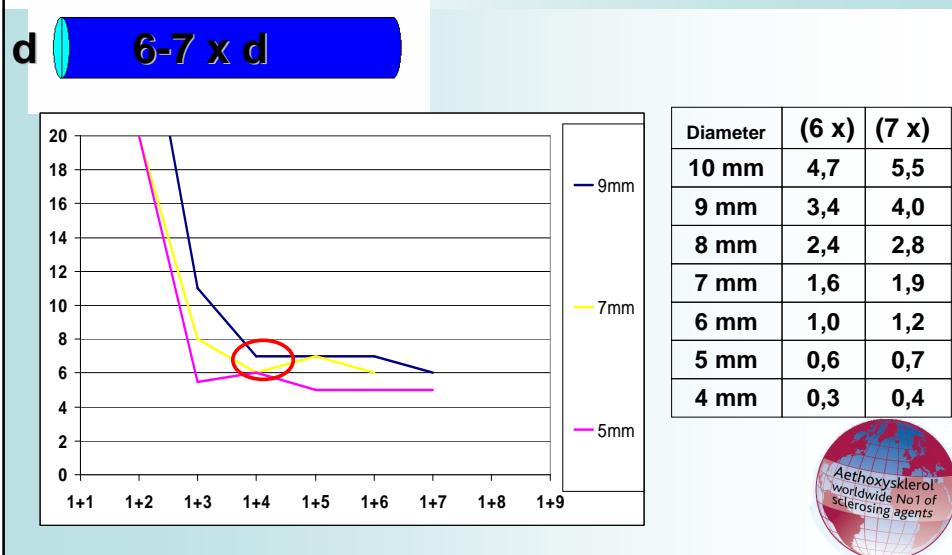
## Rheology- displacement



## Rheology



## Minimum vol for displacement



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## **2<sup>nd</sup> Consensus Meeting on Foam Sclerotherapy, Tegernsee 2006**

**2<sup>nd</sup> European Consensus Meeting  
on Foam Sclerotherapy**

**3<sup>rd</sup> International Symposium  
on Sclerotherapy**

**April 28-30, 2006  
Tegernsee, Germany**



**Thank  
you**

