IAPG SECCIONAL NORTE

Primeras Jornadas Latinoamericanas sobre Compresión de Gas Natural

Tartagal – Salta – Argentina

12, 13 y 14 de Noviembre de 2.003

Control de la Contaminación en Compresores por Medio de la Filtración y Separación de Alta Eficiencia

Contamination in Gas Process Systems

Contaminants in Gas Streams

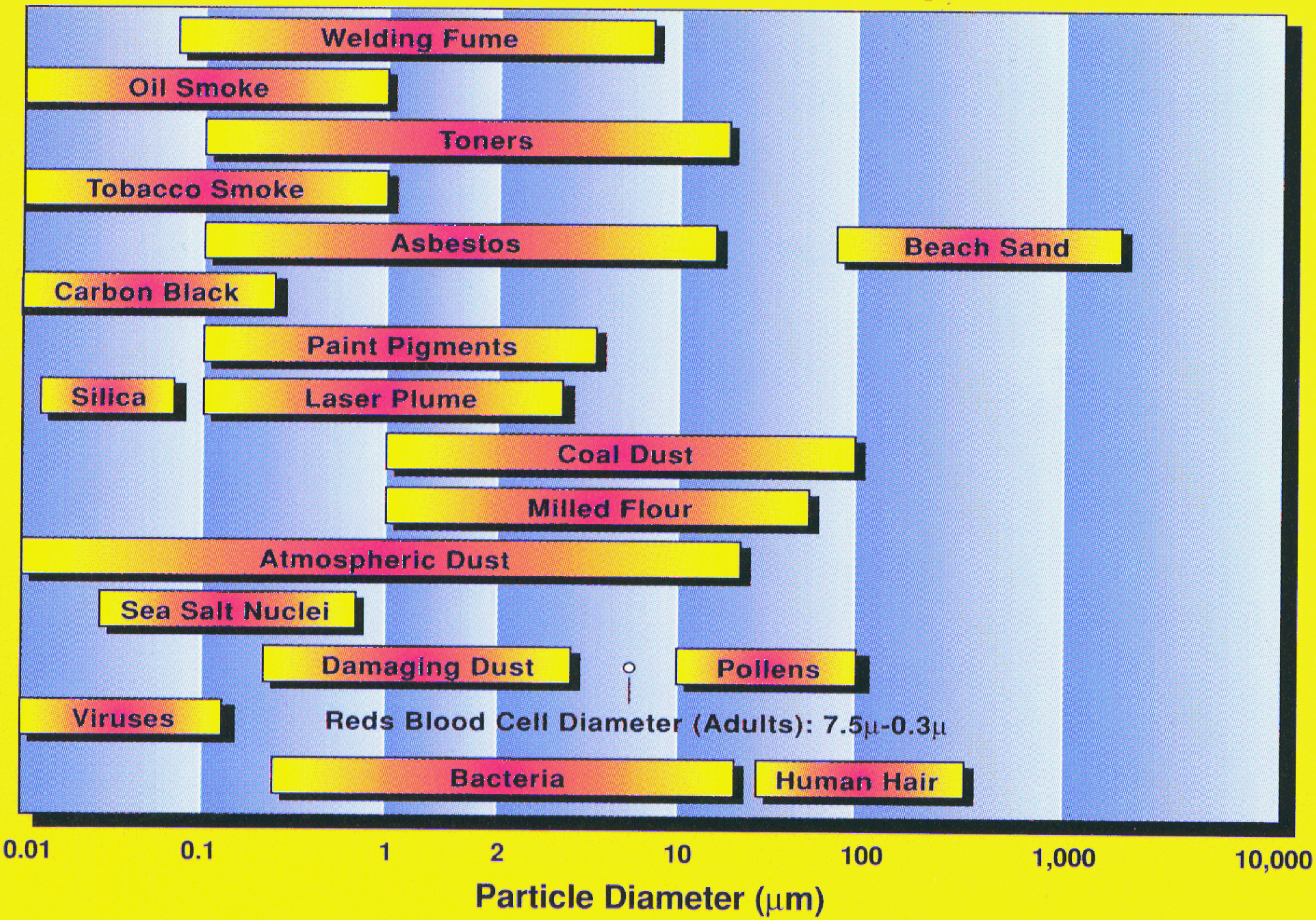
- Liquids
  - Compressor Lube Oils
  - Hydrocarbon Condensates
  - Amines
  - Glycols
  - Corrosion Inhibitors
  - Completion Fluids
  - Water
  - Brine
  - Organic Acids
- Solids
  - Iron Sulfides
  - Iron Oxides
  - Corrosion Products
  - Scale
  - Dirt (Silica, etc.)
  - Desiccant Fines

Typical Particle Size Distribution in a Compressed Gas Stream

	Particle Size Distribution (µm)				
	1-5	5-15	15-25	25-50	50-100
Silica	64%	21%	11%	3%	1%
Iron Sulfide*	99%	1%	-	-	-
Iron Oxide	82%	16%	1%	1%	-
Desiccant	50%	21%	28%	1%	-

* Iron Sulfide particles are predominantly formed in the sub-micron range but agglomerate together to form particles greater than 1 µm.

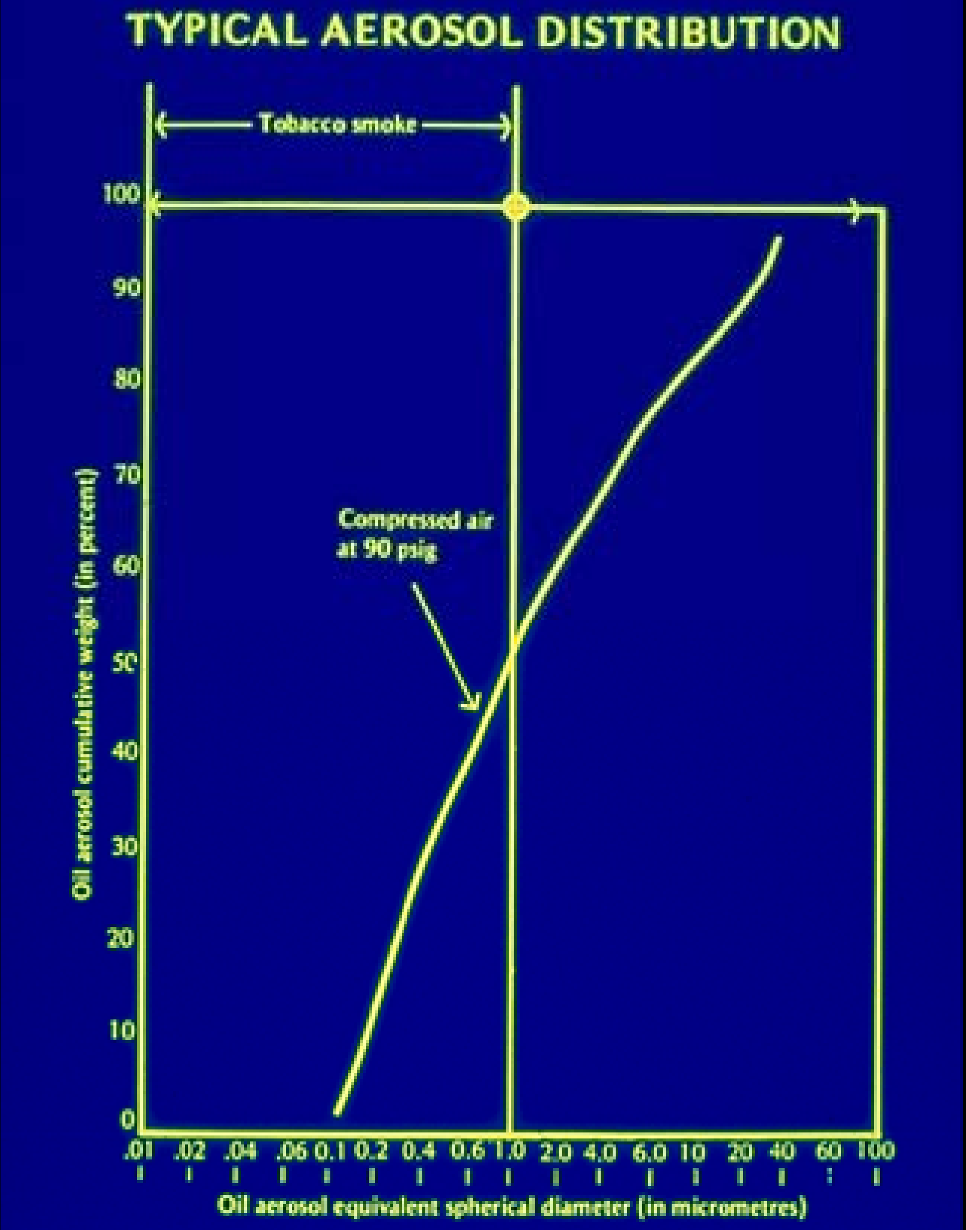
Typical Particles and Gas Dispersoids



Media Pore Size Distribution Test Stand

Aerosol Generators

- Compressors & After-coolers
- Pressure Reduction Valves
- Restricted Port Valves
- Orifice Plates - Metering Equipment
- Extended Piping Runs & Ells
- Heat Exchangers
- Chemical Injection Pumps
- Overheads from Contactors



TYPICAL AEROSOL DISTRIBUTION
Tobacco smoke
Compressed air at 90 psig
Oil aerosol cumulative weight (in percent)
0
10
20
30
40
50
60
70
80
90
100
.01 .02 .04 .06 0.1 0.2 0.4 0.6 1.0 2.0 4.0 6.0 10 20 40 60 100
Oil aerosol equivalent spherical diameter (in micrometres)

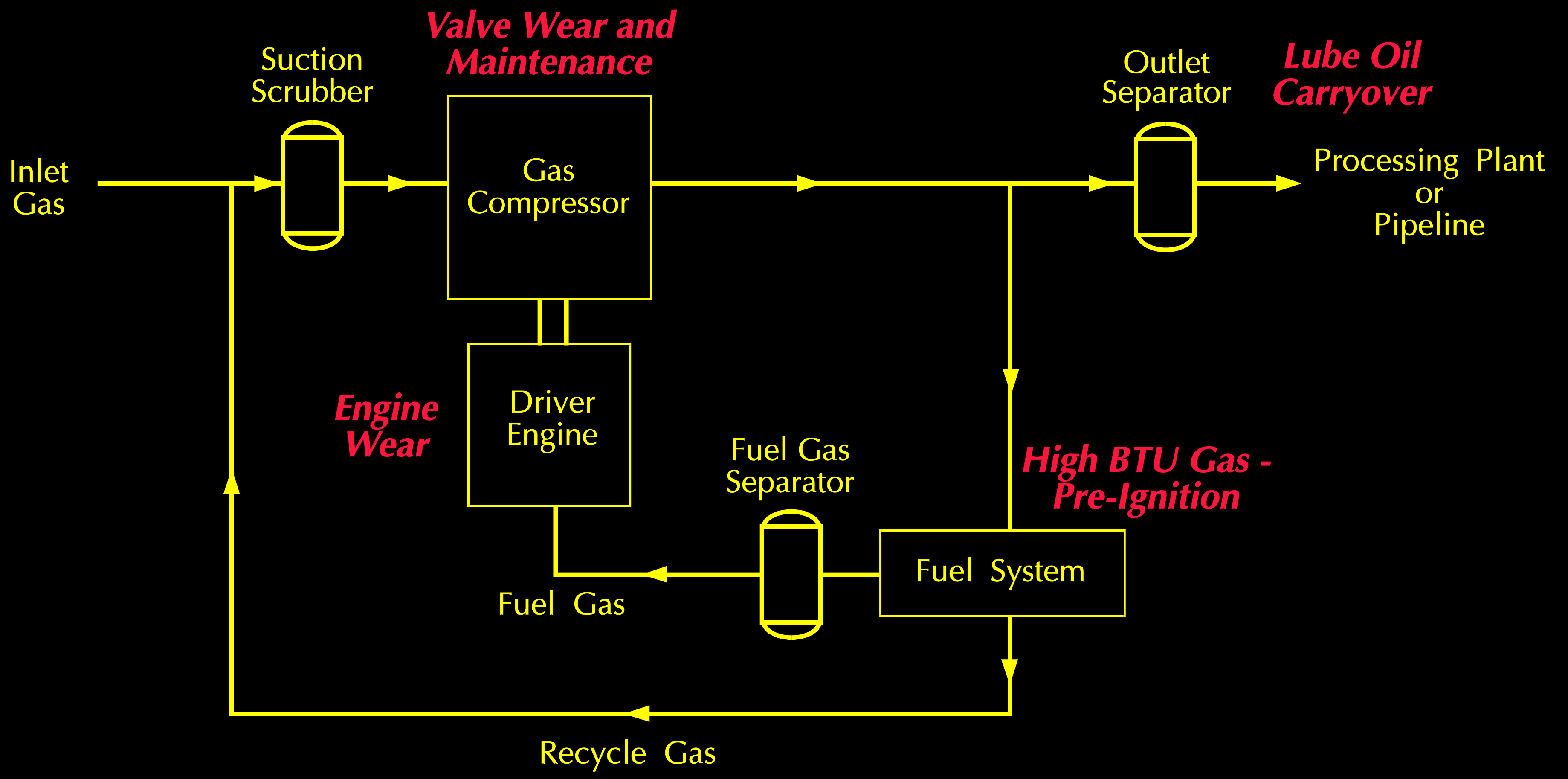
Large Flow Liquid/Gas Separator Test Stand

Historical Impact of Conventional Filtration and Separation Methodology

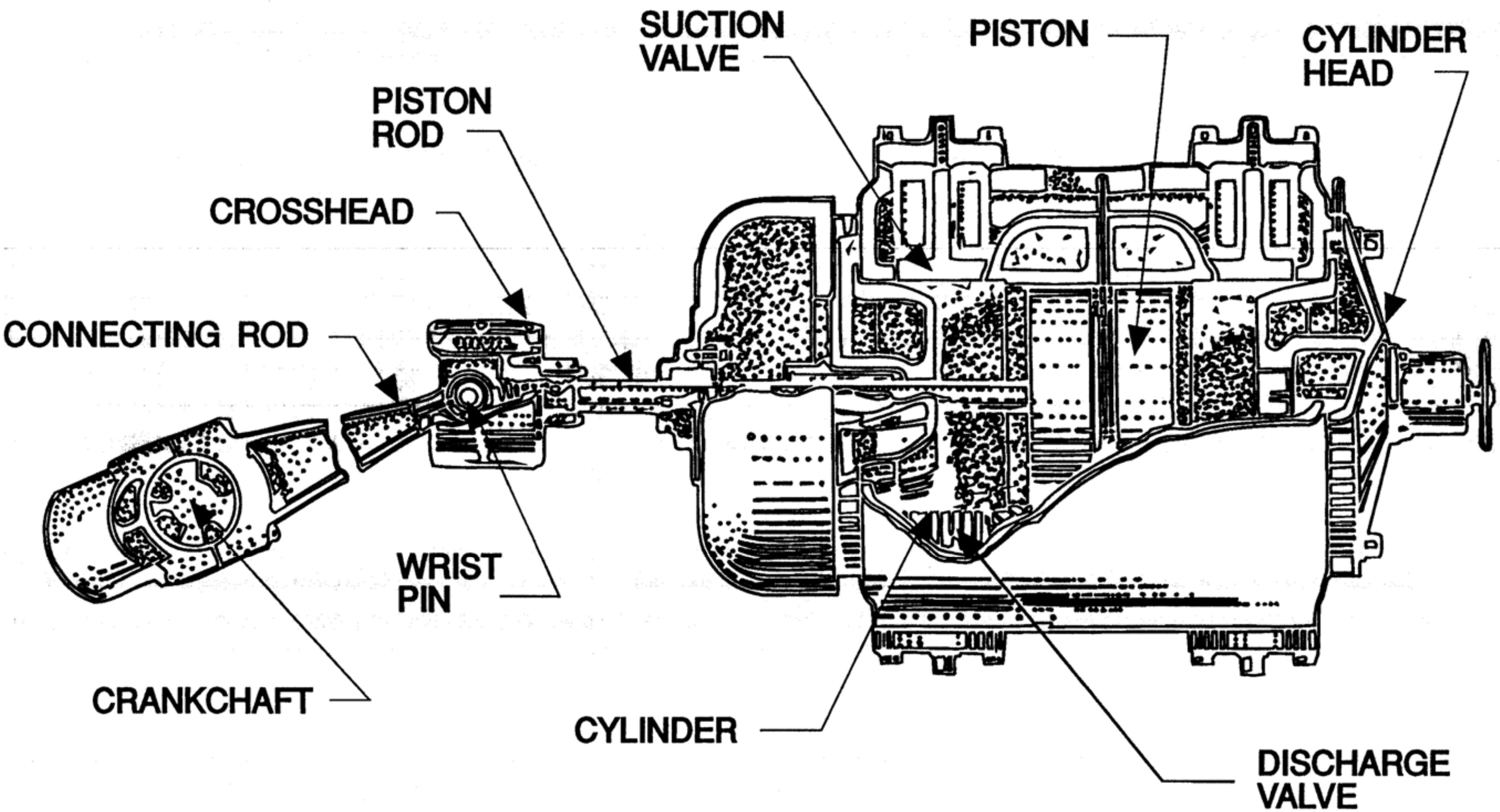
Contamination in Natural Gas Streams

- Liquid carryover and slugs
- Liquid aerosols (stable mist)
- Particulate (solids)

Typical Compressor System



Elements of a Typical Reciprocating Compressor



Process Control

Effective Process Control

<u>requires</u> effective

Contamination Control!

Liquid Filtration Ratings

- **NOMINAL.** ***Arbitrary rating set by manufacturer.***
- **ABSOLUTE.** ***Largest spherical particle which will pass through media under specified test conditions.***
- **BETA RATING.** ***Or Beta filtration ratio.***

Beta Filtration Ratio

$$\beta_x = \frac{\text{No. of particles upstream} \geq x\ \mu m}{\text{No. of particles downstream} \geq x\ \mu m}$$

Beta Filtration Ratio Example

No. particles upstream > 5 µm = 25,000
No. particles downstream > 5 µm = 5

$$\beta_5 = \frac{25,000}{5} = 5,000$$

MICROFORM® Media

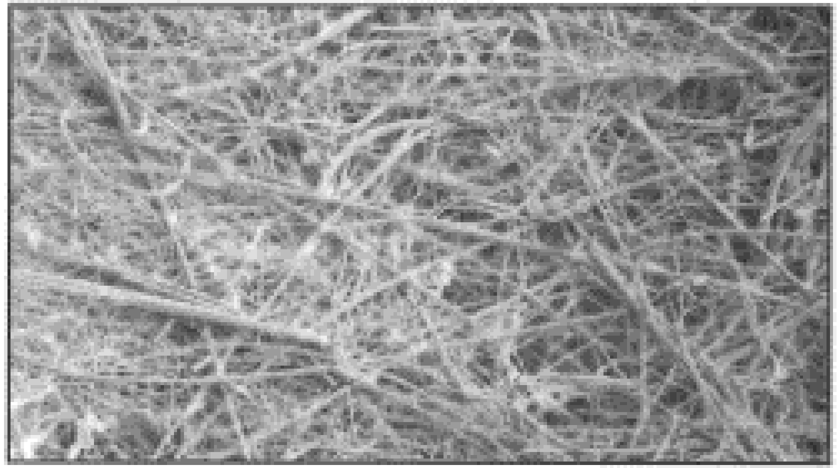


Fig. 3 Scanning Electron Micrograph of MicroForm™ media: $\beta_2 = 5{,}000$.
500X magnification

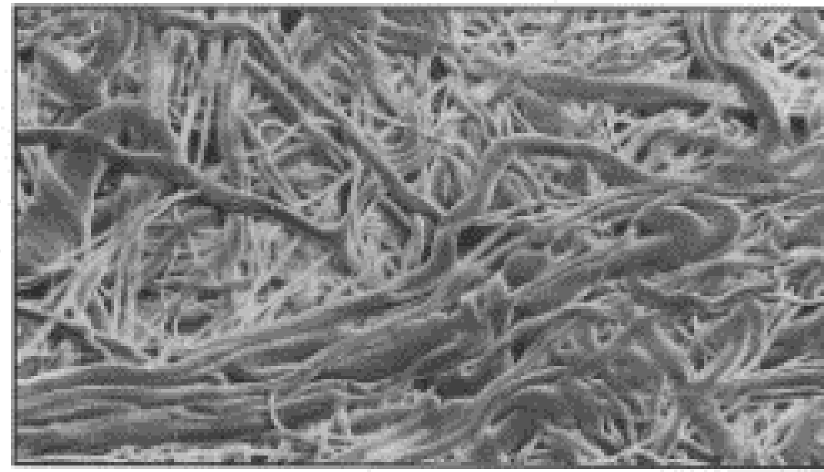


Fig. 4 Scanning Electron Micrograph of melt-blown polypropylene media: $\beta_{2.5} = 5{,}000$
500X magnification

Fig. 5 Scanning Electron Micrograph of string wound media (5 μm nominal): $\beta_5 < 1.1$.
500X magnification

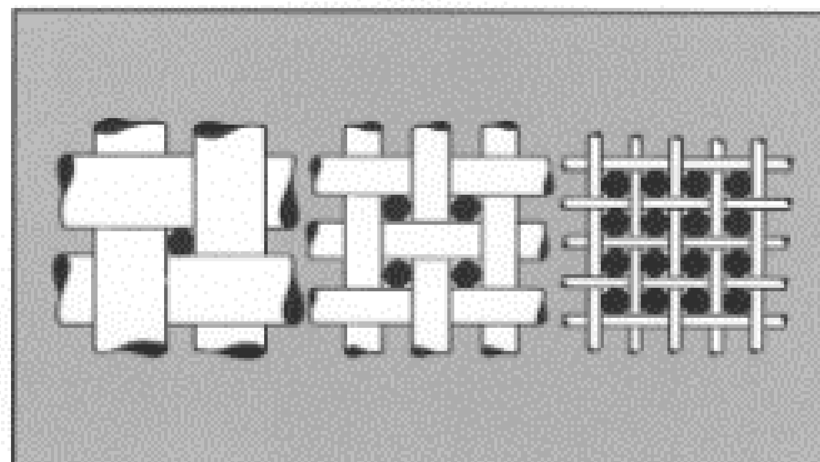
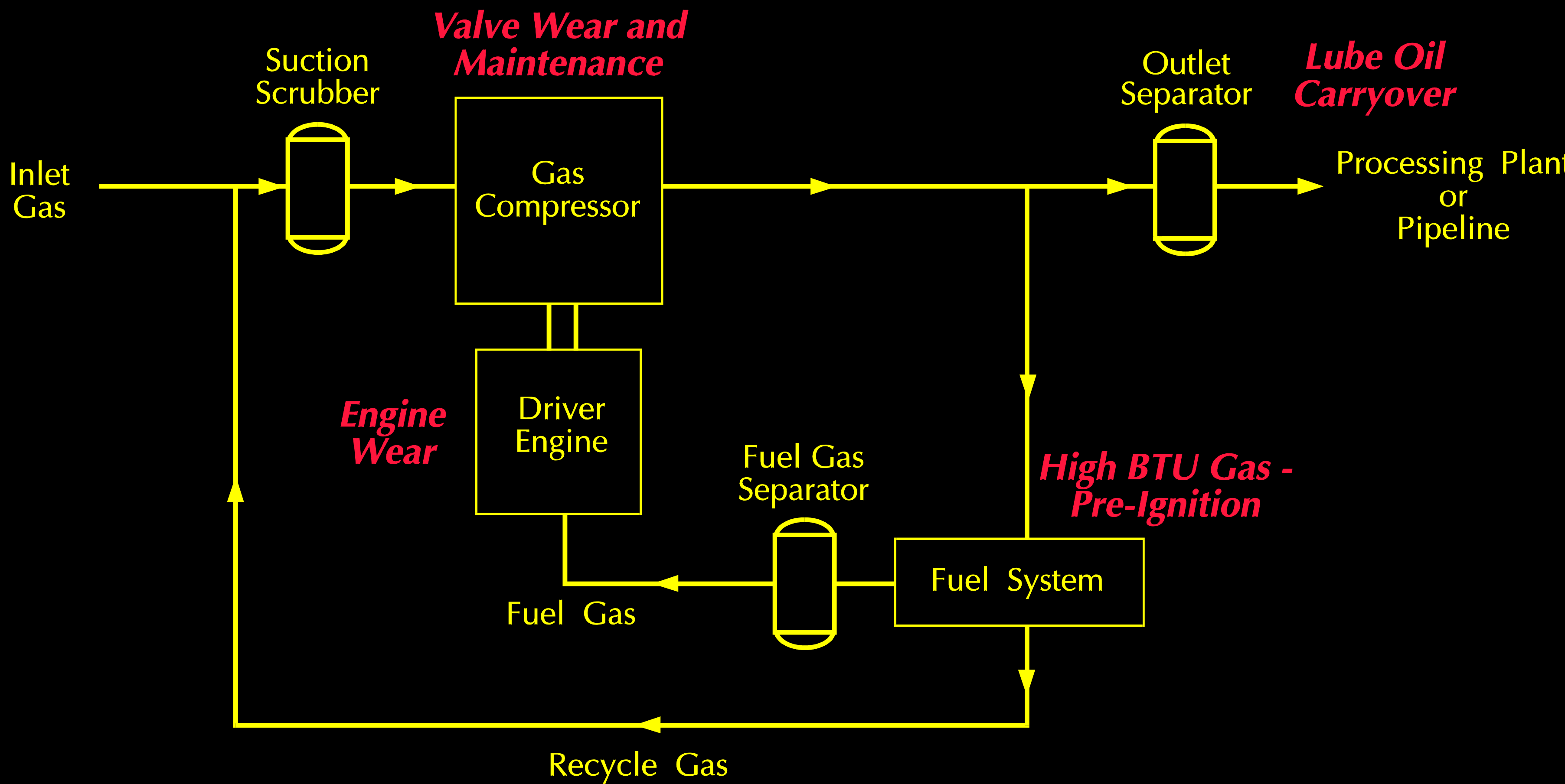


Fig. 6 Variation in Permeability as a Function of Fiber Diameter.

Balanced Systems Approach

- Balances the entire system to allow the plant to operate at maximum operating efficiencies.
- Balanced systems continue to function under conditions of statistical fluctuations, or upsets, with little or no loss in plant efficiencies.

Typical Compressor System



Objective of Filtration

Provide the optimum fluid quality or cleanliness level required for the application at the lowest overall operating cost.

Cost-of-Filter-Ownership

- Effluent Fluid Quality: Operating Costs
- Initial Price
- Life
- Labor Costs
- Shipping, Handling and Inventory
- Future Liability
- Disposal Costs