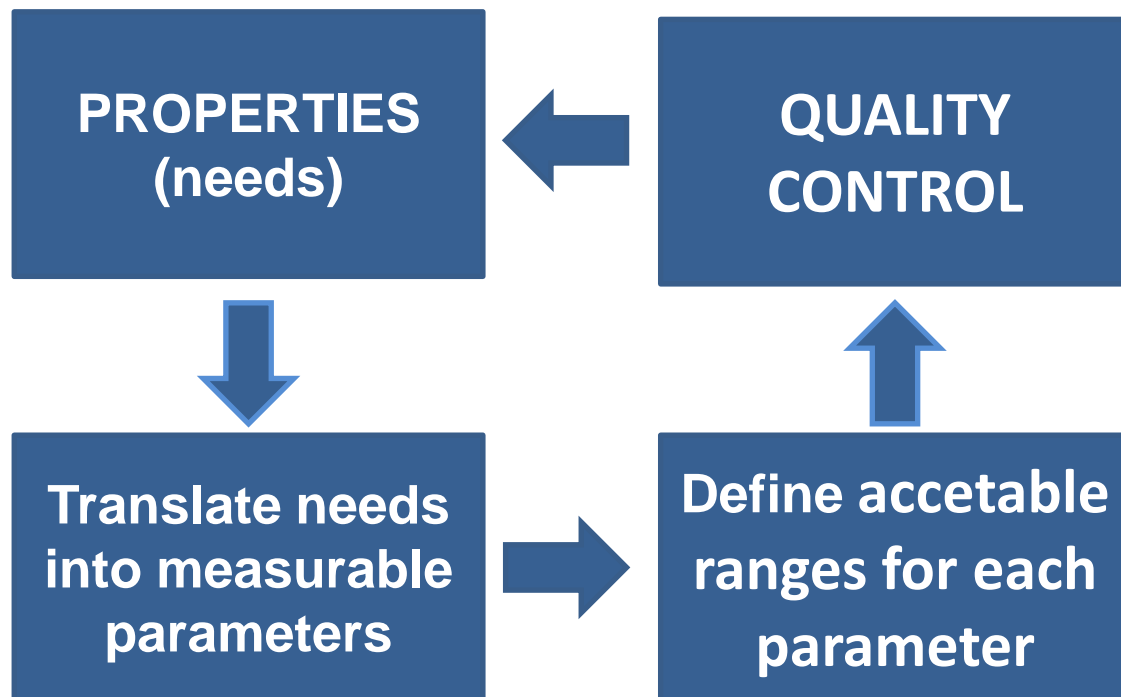
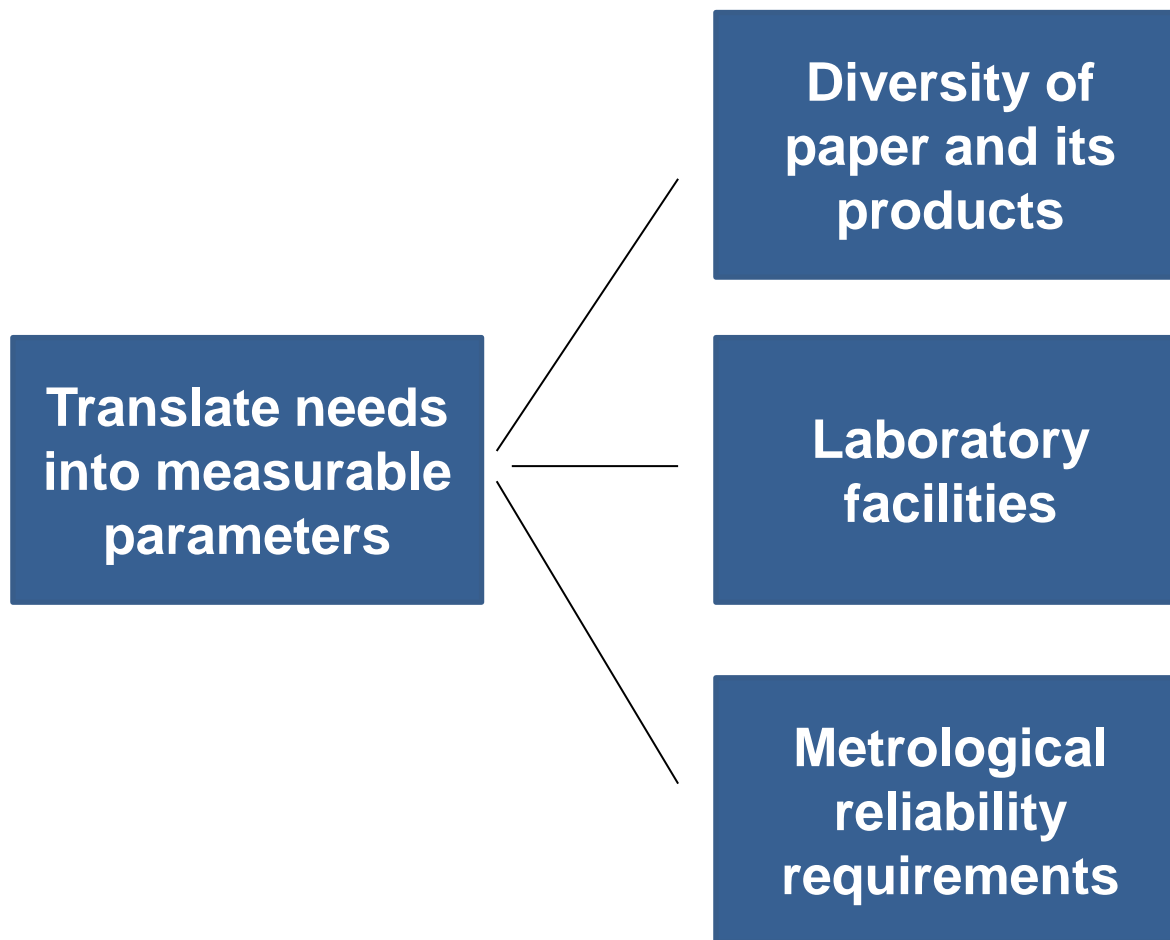


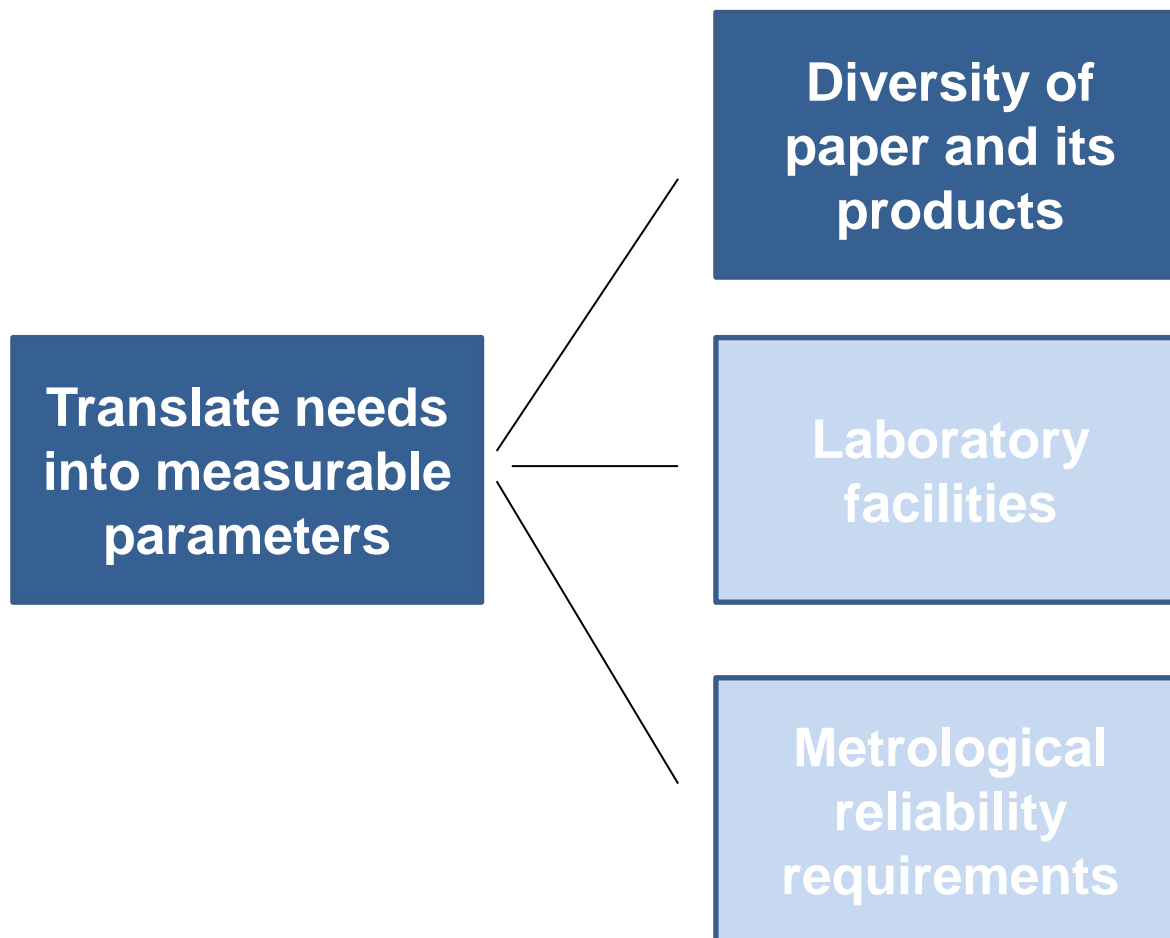


## PAPER AND ITS PRODUCTS: PROPERTIES AND QUALITY CONTROL

**Maria Luiza Otero D'Almeida**

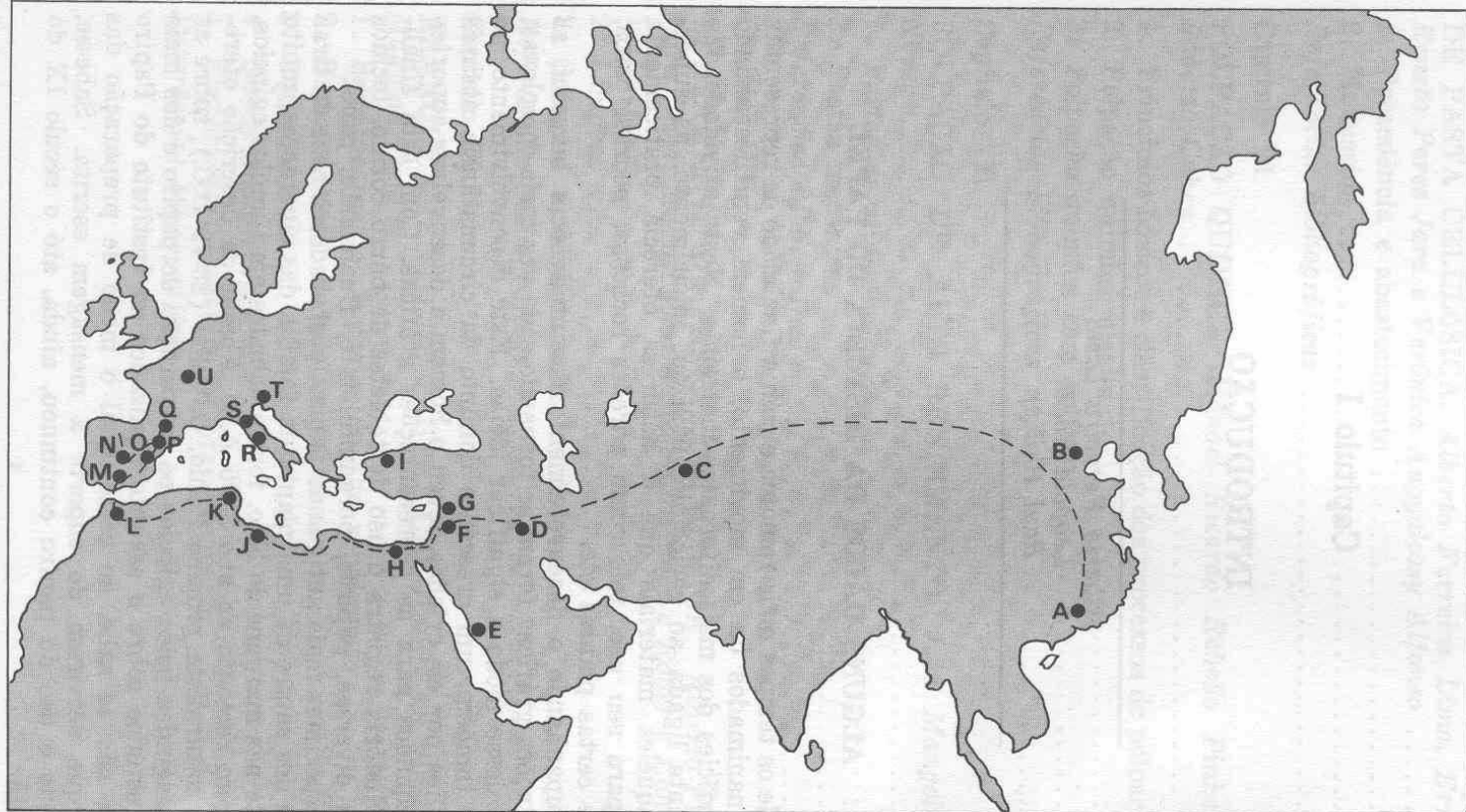








Over centuries the development  
in the manufacture of paper was  
led by paper for writing and  
printing



A- CANTON; B- BEIJING; C- SAMARKAND; D- BAGHDAD; E- MECCA; F- DAMASCUS  
G- HAMA; H- ALEXANDRIA; I- CONSTANTINOPLE; J- TRIPOLI; K- TUNIS; L- FEZ  
M- CORDOBA; N- TOLEDO; O- VALENCIA; P- BARCELONA; Q- CAPELADES; R- ROMA  
S- BOLOGNA; T- VENICE; U- RICHARD DE BAS



## **EUROPA**

**SPAIN 1131**  
**ITALY 1276**  
**FRANCE 1348 (?)**  
**GERMANY 1390**  
**SWEDEN 1411**  
**POLAND 1491**  
**ENGLAND 1494**  
**AUSTRIA 1498**  
**BOHEMIAN 1499**  
**HUNGARY 1546**  
**RUSSIA 1576 (?)**  
**NETHERLANDS 1586**  
**SCOTLAND 1591**  
**DENMARK 1635**  
**NORWAY 1690**

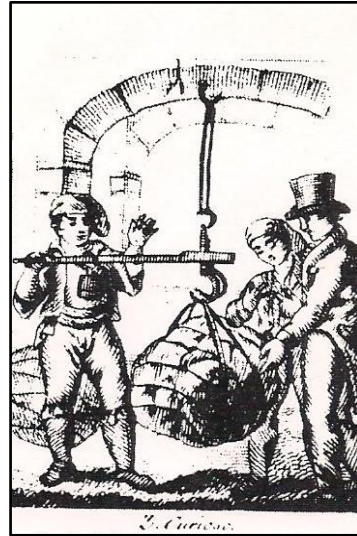
Source: Dard Hunter. Papermaking: The history and technique of an ancient craft, Dover publication, 1974

## **AMERICA**

**MEXICO 1574**  
**UNITED STATES 1690**  
**CANADA 1803**  
**BRAZIL 1820**

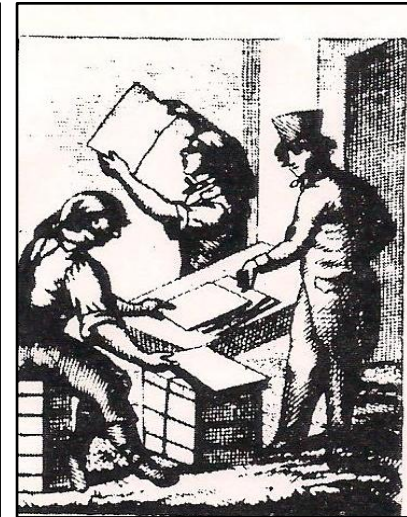
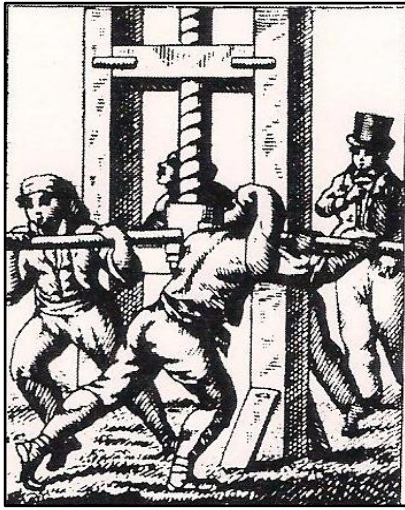
Source: Leopold Rodés, A feitura do papel manual,  
Revista "O papel" , abril 1994.





Source: *A lively look at paper making* (century XVIII). Paper Conservator, 1998.





Source: *A lively look at paper making* (century XVIII). Paper Conservator, 1998.



Demand for paper →  
increase of the production →  
rag's price increase →  
search for new raw material



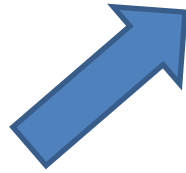
## PRICE OF RAGS IN MASSACHUSETTS - USA

YEAR	PRICE Pennies/ pounds
1777	3
1778	8
1779	12

Source: Dard Hunter. Papermaking: The history and technique of an ancient craft, Dover publication, 1974



## **XIX CENTURY**



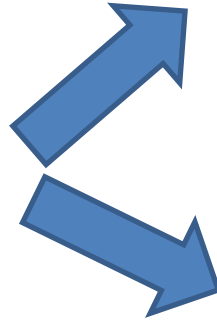
### **Marked by important developments in papermaking**

- Introduction of rosin sizing
- Introduction of hydraulic press
- Fourdrinier paper – machine
- Introduction of calcium sulphate as filler
- Introduction of drying-rolls
- Discovery of aniline dye (used for colouring paper)
- Sulphite process
- Sulphate process





**XIX CENTURY**



**Marked by important developments  
in papermaking**

**Flourishing of other uses for paper  
than printing and writing**



YEAR	EVENT
1850	Paper bags made for the first time, entirely by hand. The earliest automatic paper bag machine was built in 1876.
1894	About this time automatic machines for the making of paper boxes were in general use, the beginning of packaging era.
1899	The use of toilet paper was universal. But in 875 Arab travellers in China report having seen toilet paper in use in that country during the ninth century.
1901	In England compressed paper had become a standard material for the construction of interiors of railway carriages, military hospital buildings, etc.
1903	First use of corrugated fibre containers, replacing wood boxes to a great extent.

Source: Dard Hunter. Papermaking: The history and technique of an ancient craft, Dover publication, 1974





## XX Century



**Major developments in processes and technology to manufacture printing/writing, sanitary, packaging and special purposes papers.**

**1893**

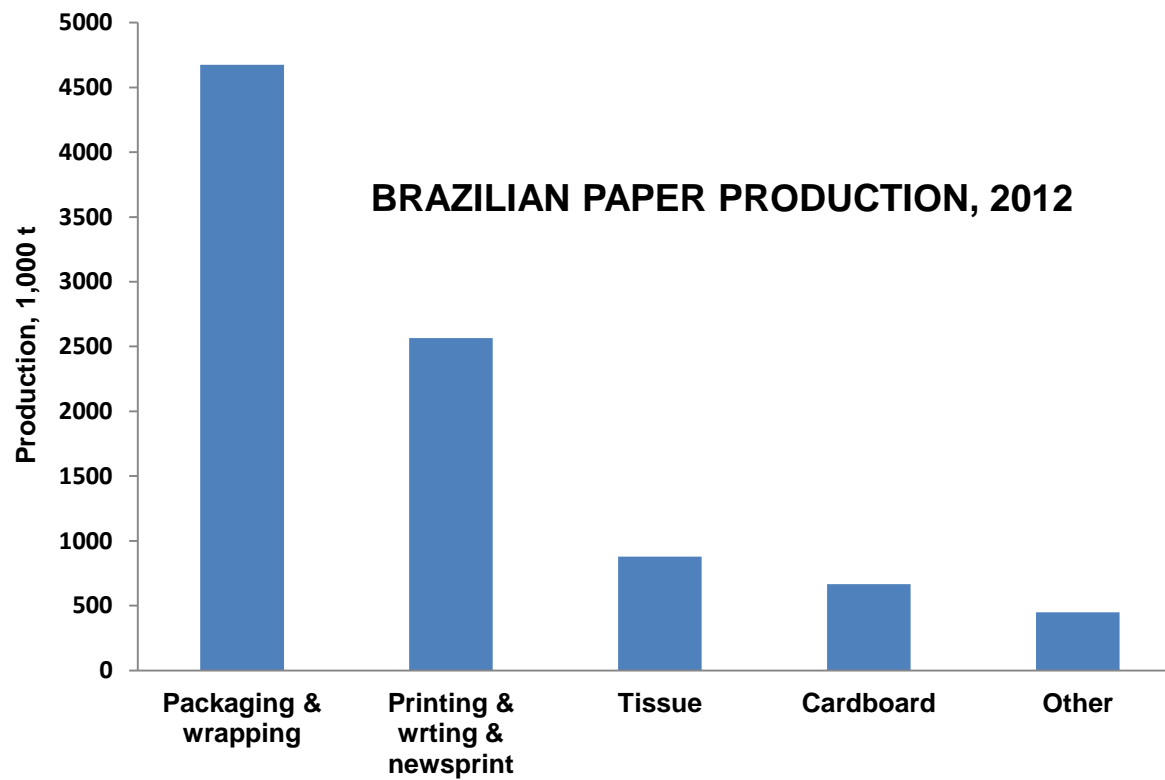
**Largest paper machine in the world (Star mill, England) produced paper 55 cm wide. The machine was able to produce 10t/ day.**

**Source: Dard Hunter. Papermaking: The history and technique of an ancient craft, Dover publication, 1974**

**2013**

**Largest paper machine in the world (Hainan Jinhai Pulp & Paper Co., Hainan, China) produces paper 1180 cm wide. It is able to produce 4537t/day. Maximum operating speed: 1700m/min.**

**Source: 31/ 2010 / Voith Paper / together – page 16-19**



Source: Bracelpa, Conjuntura Bracelpa 49

<<http://www.bracelpa.org.br/bra2/sites/default/files/conjuntura/CB-013.pdf>.>



PRINTING &  
WRITING



Printing: printability and runnability.  
Writing: sliding of pen or pencil and show through.

PACKAGING



Contain, protect and facilitate the transport of products.  
Inform consumers and sell from compelling visuals.

TISSUE

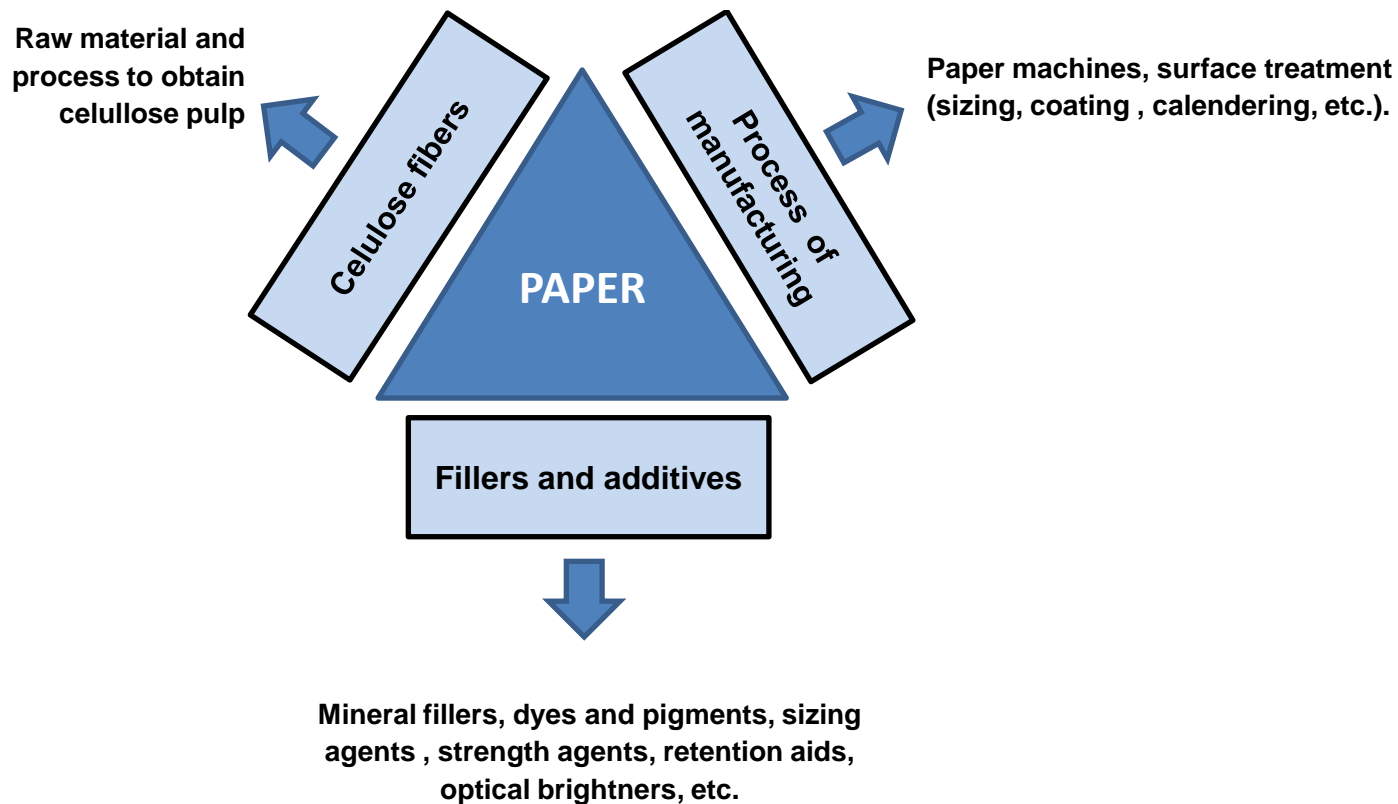


Absorb and retain liquids.

OTHERS  
(special papers)



Varied functions.



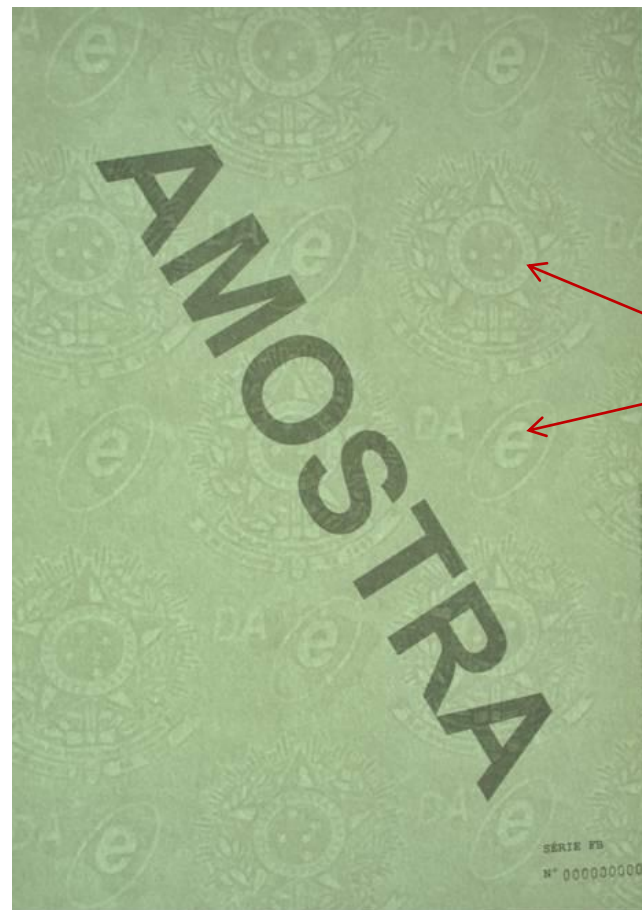


IPT collection



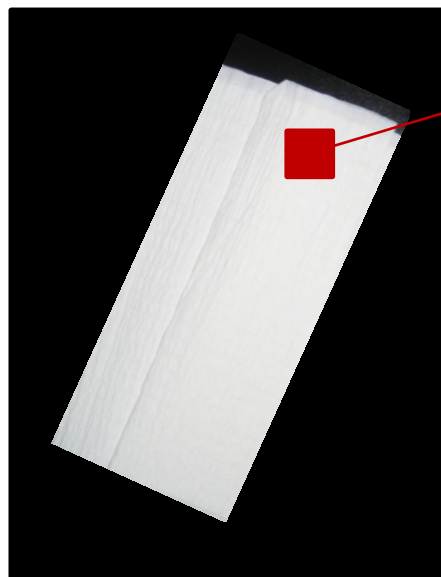


Security paper seen in transmitted light

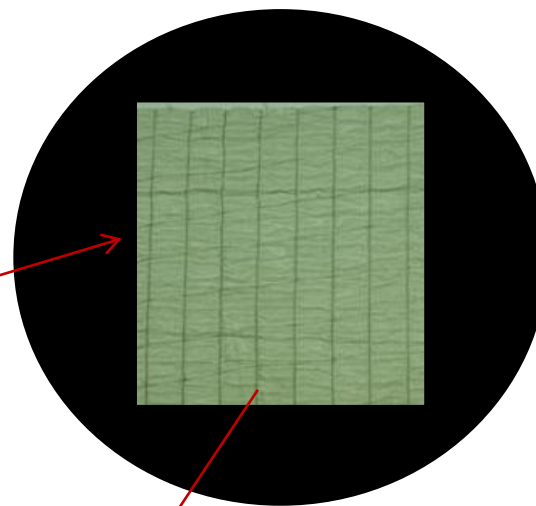


Water marks

IPT collection,

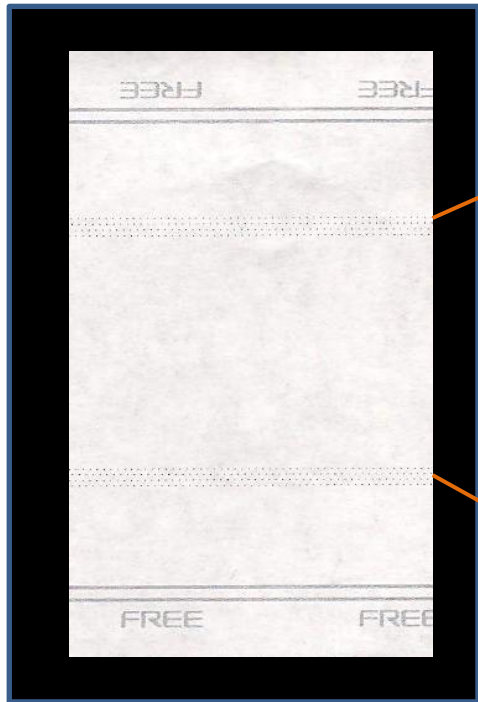


Paper wiping cloth

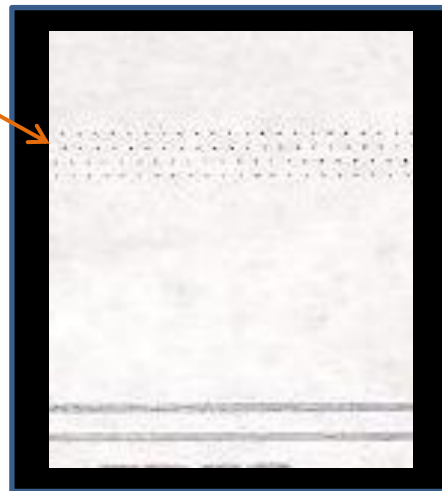


Nylon thread

IPT collection

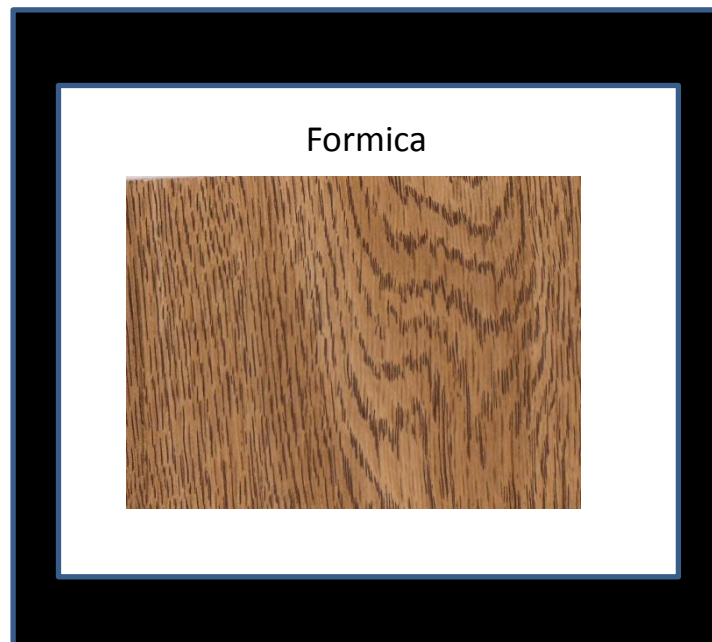


IPT collection





IPT collection





**DIN – Deutsches  
Institut für  
Normung**

**JIS – Japanese  
Standards Association**

**ABNT – Associação  
Brasileira de  
Normas Técnicas**

**EN- European  
Standard**

**ARSO – African  
Organization for  
Standardization**

**CSA - Canadian  
Standards Association**

**TAPPI – Technical  
Association of pulp  
and paper industry**

**ASTM – American  
Society for Testing  
and Materials**

**AFNOR – Association  
Française de  
Normalisation**

**BSI – British  
Standards**

**ISO – International  
Organization for  
Standardization**

**IEC – International  
Eletrotechnical  
Comission**





## IPT method

A paper ball of defined mass and diameter is made and placed in a teste tube. A defined volume of water is added in the test tube and shaking for a set time is carried out.



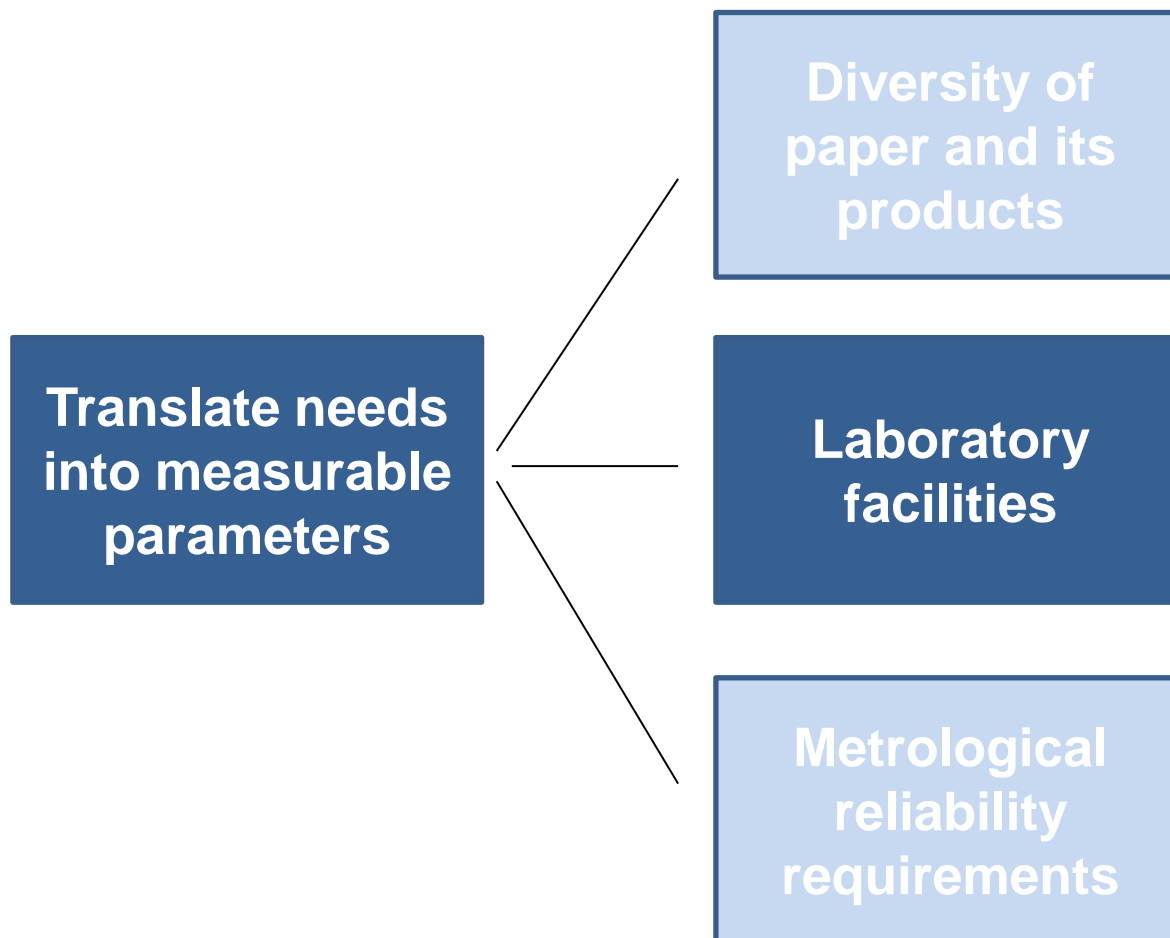
Disaggregates



Does not disaggregate



Sources: <<http://www.nsf.org/newsroom/nsf-international-certifies-first-product-to-flushable-products-certificati/>>  
Acessed: set/2013





## LABORATORY FOR PHYSICAL TESTING

**Structural  
properties**

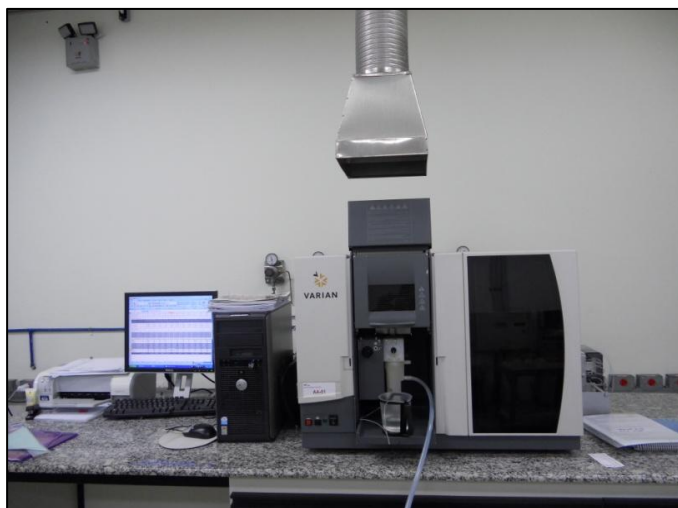
**Mechanical  
properties**

**Appearance  
properties**





## LABORATORY FOR CHEMICAL ANALYSIS



Atomic absorption spectrometry (AA)



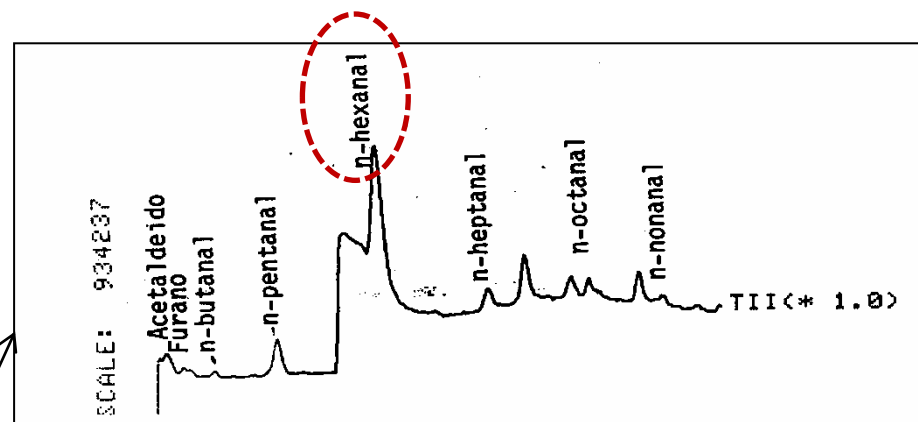
Atomic emission spectrometry (ICP-OES)



Liquid chromatography coupled to high-resolution mass spectrometry (Q-TOF)



Gas chromatography coupled to mass spectrometry



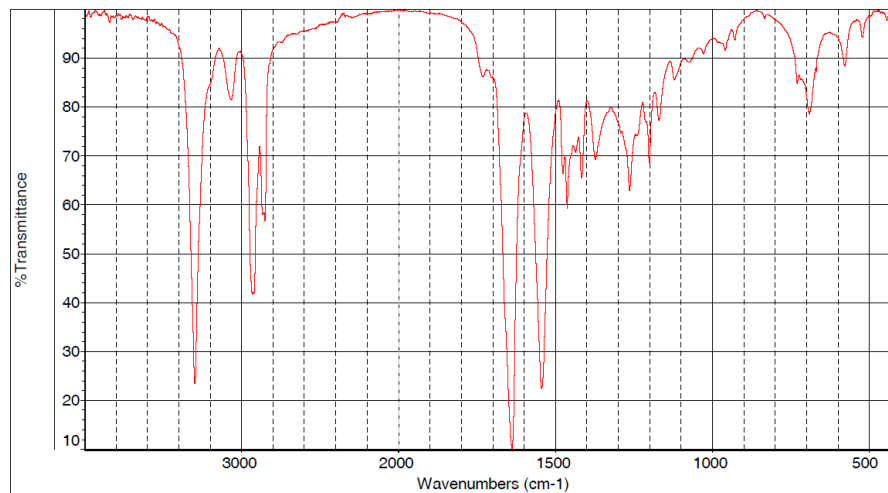




IR spectrophotometer with ATR

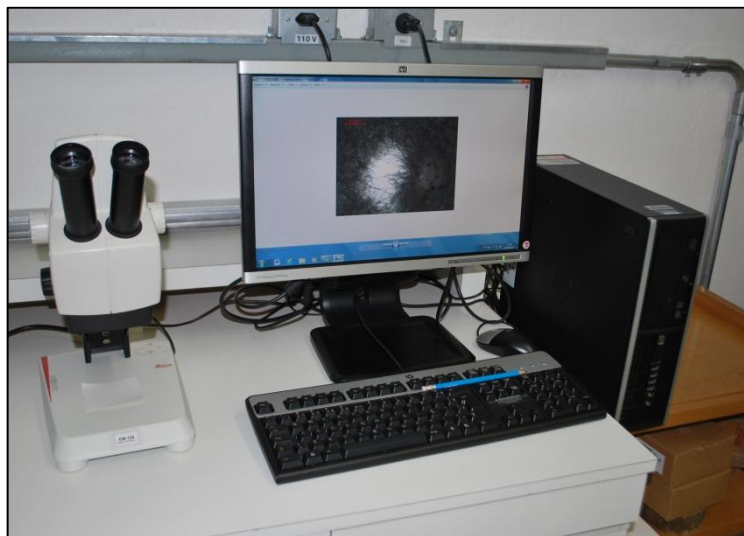


Thermogravimetry (TGA) coupled to FIIR

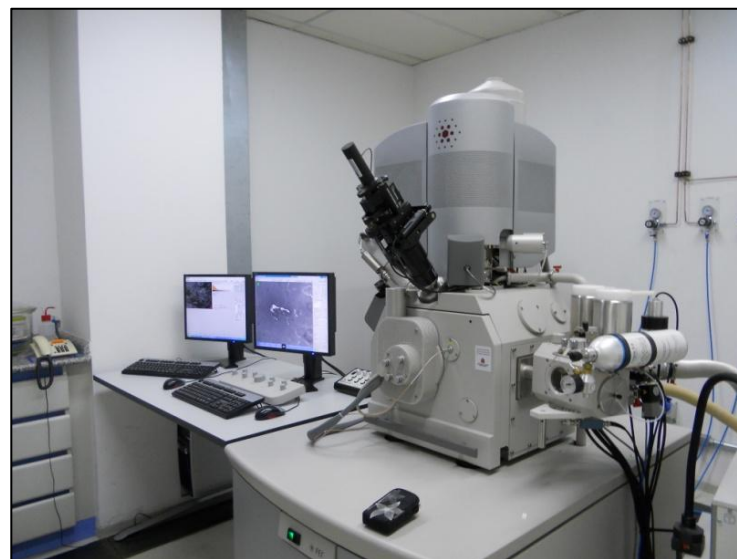




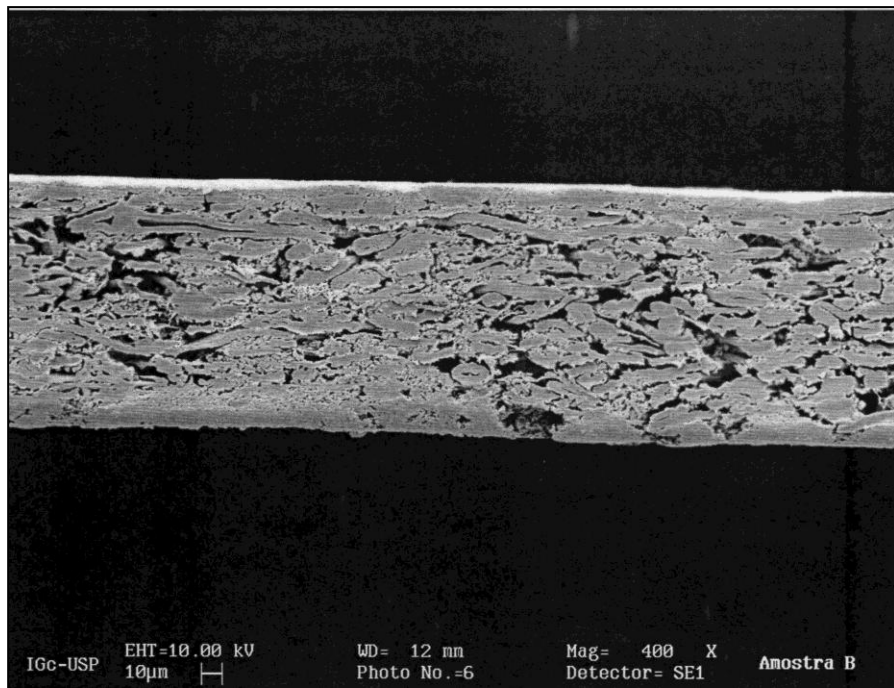
## LABORATORY FOR MICROSCOPIC EXAMINATION



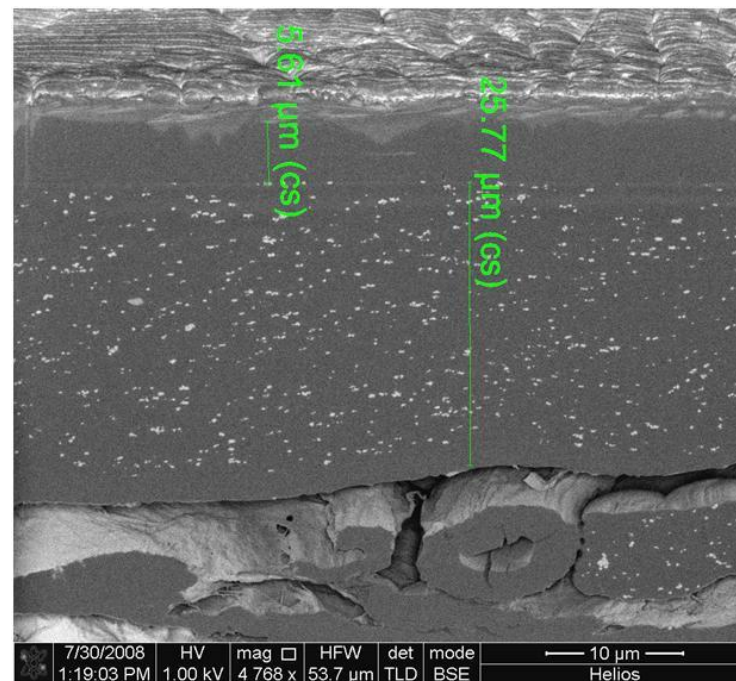
Loupe



Electron microscope  
FIB – FEI – 3D- Quanta FEB

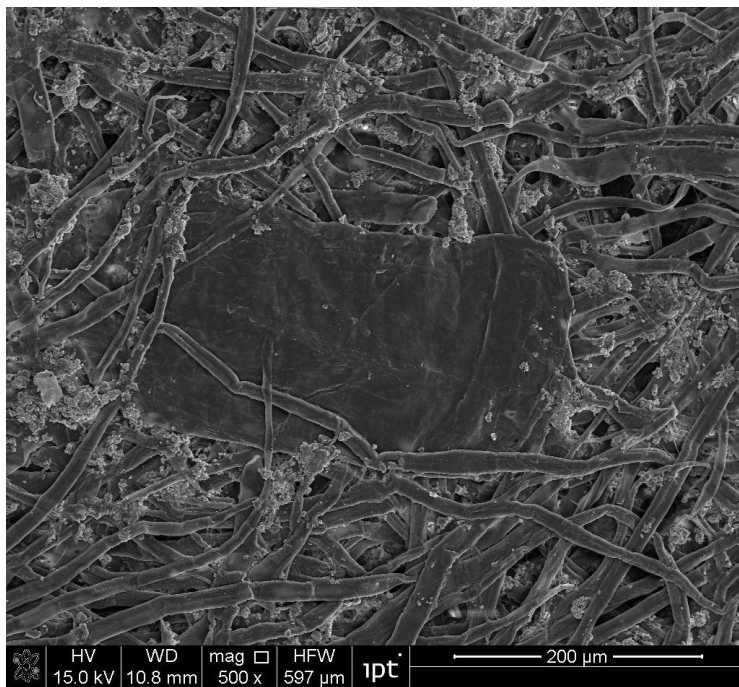


IPT collection

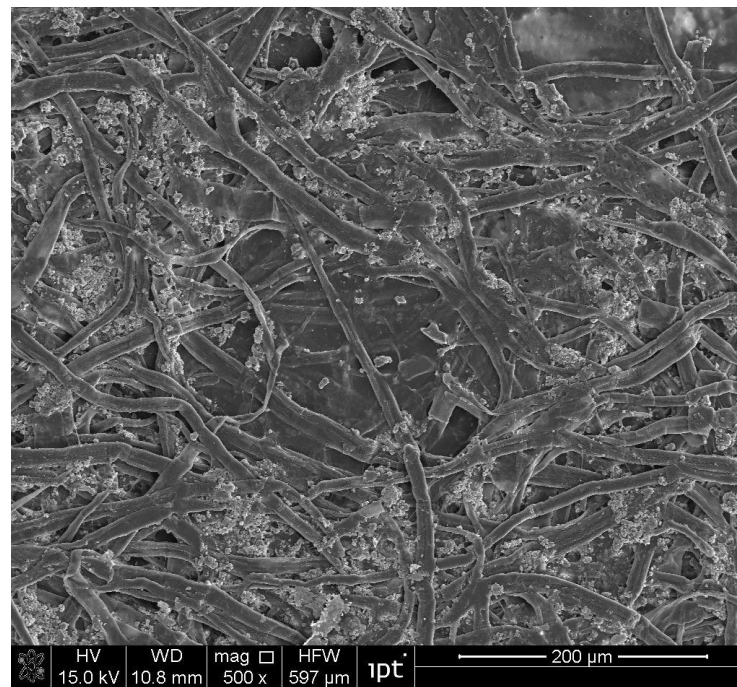


IPT collection

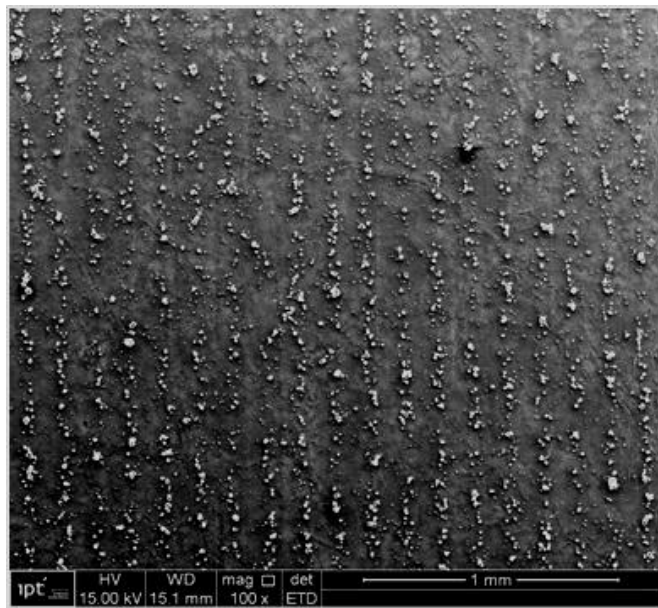




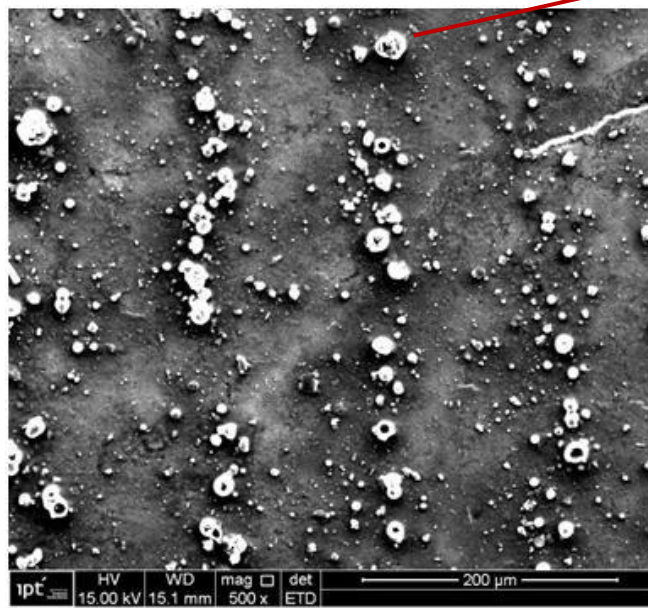
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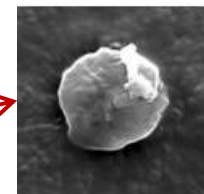
IPT collection,



IPT collection

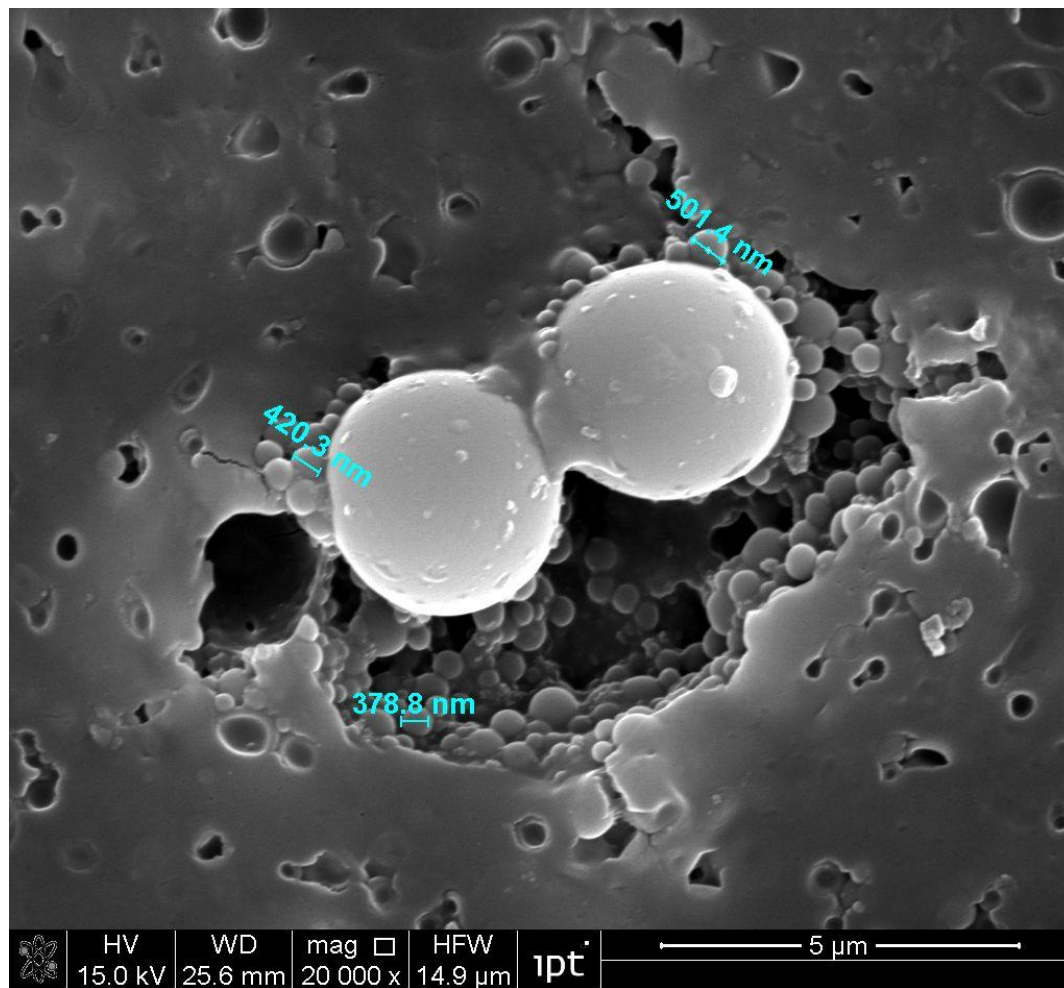


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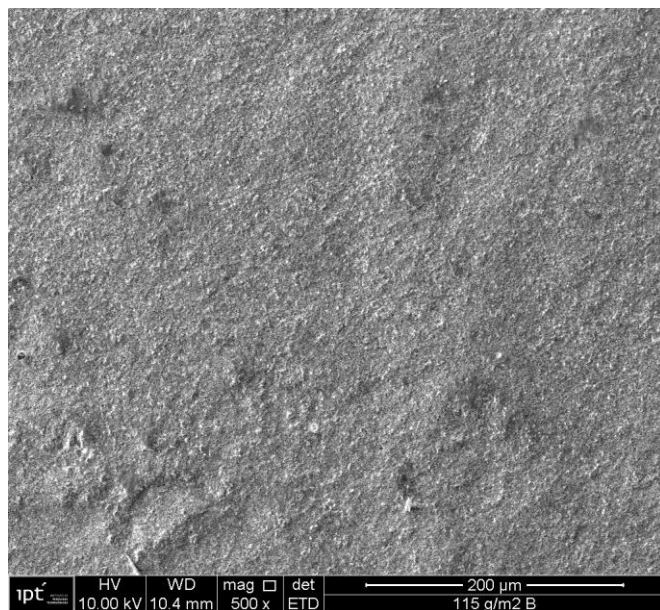
5.000 x

Capsules with perfume on paper surface

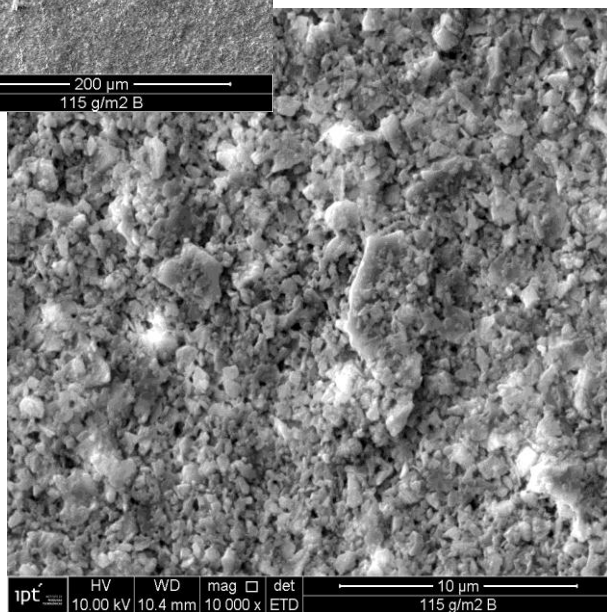


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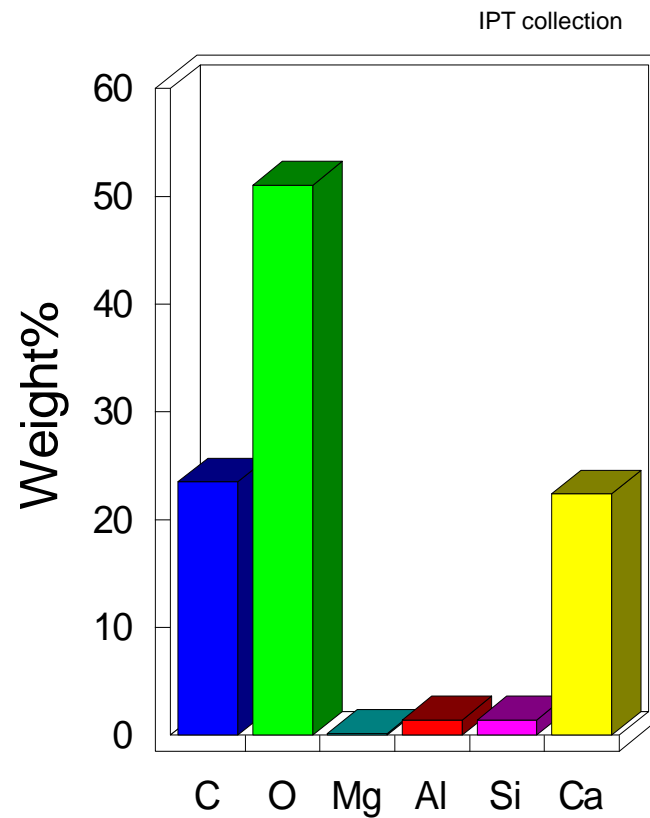




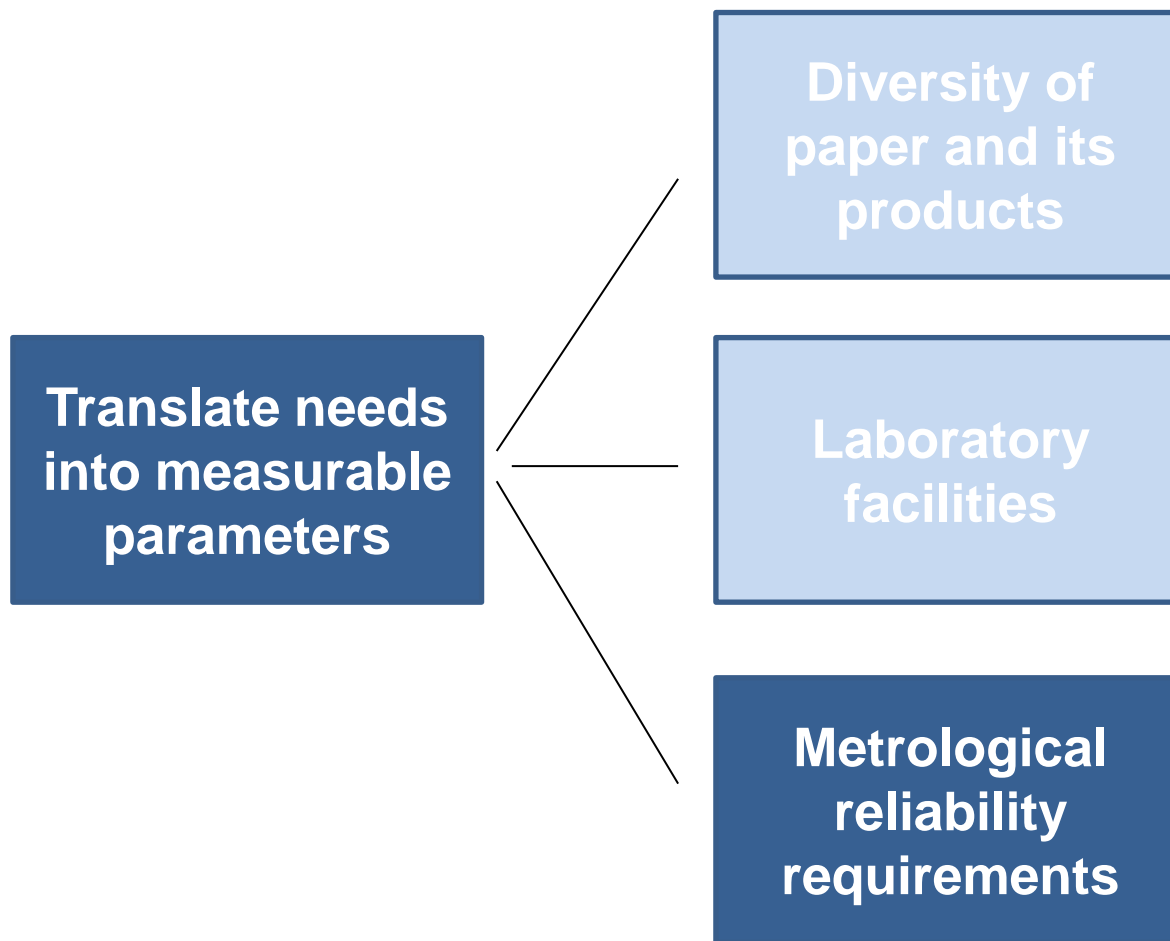
IPT collection



IPT collection



Electron microscopy MEV/FEG, FEI,  
QUANTA 400





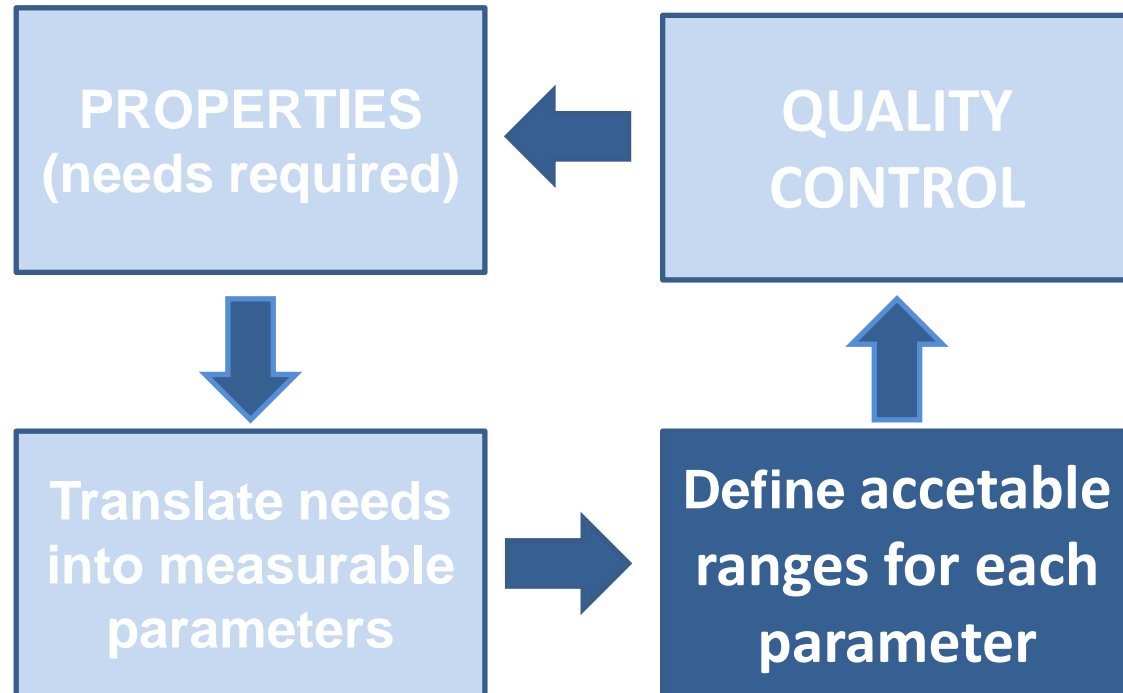
**Laboratories  
must guarantee  
metrological reliability  
of their results**

**Implementing  
a quality system**

**External assurance  
of the quality**

**ISO/IEC:17025 - General  
requirements for the  
competence of testing and  
calibration laboratories**

**Interlaboratory program**





## Define acceptable ranges for each parameter

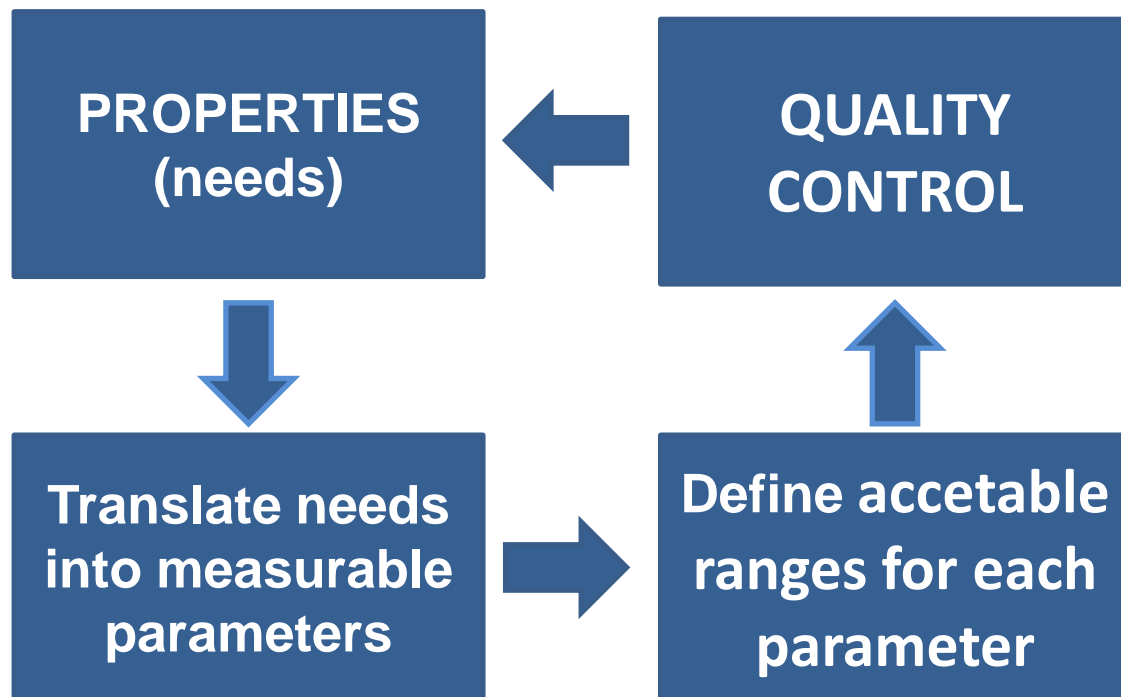
internal

external

**Based on historical values and production facilities**

**Based on values available on the market and needs identified**

- **Technology (available, new, local)**
- **Local capacity in manufacturing**
- **Environment requirements**
- **Policies (degree of local involvement)**
- **Market**
- **Conflicting interest**
- **Investments**
- **Etc.**







## FINAL REMARKS

**Quality control is essential**



- consumers and buyers are becoming more demanding

**High cost to assemble and maintain a laboratory**



- Need of higher skilled personnel
- Equipments are more complexes and have fast obsolescence
- Metrological requirements

**Partnership emerge as a necessity**



- Diversity of products and more sophisticated products
- Need for multidisciplinary knowledge
- Volume of technical information available

Thank you!

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[lpc@ipt.br](mailto:lpc@ipt.br)