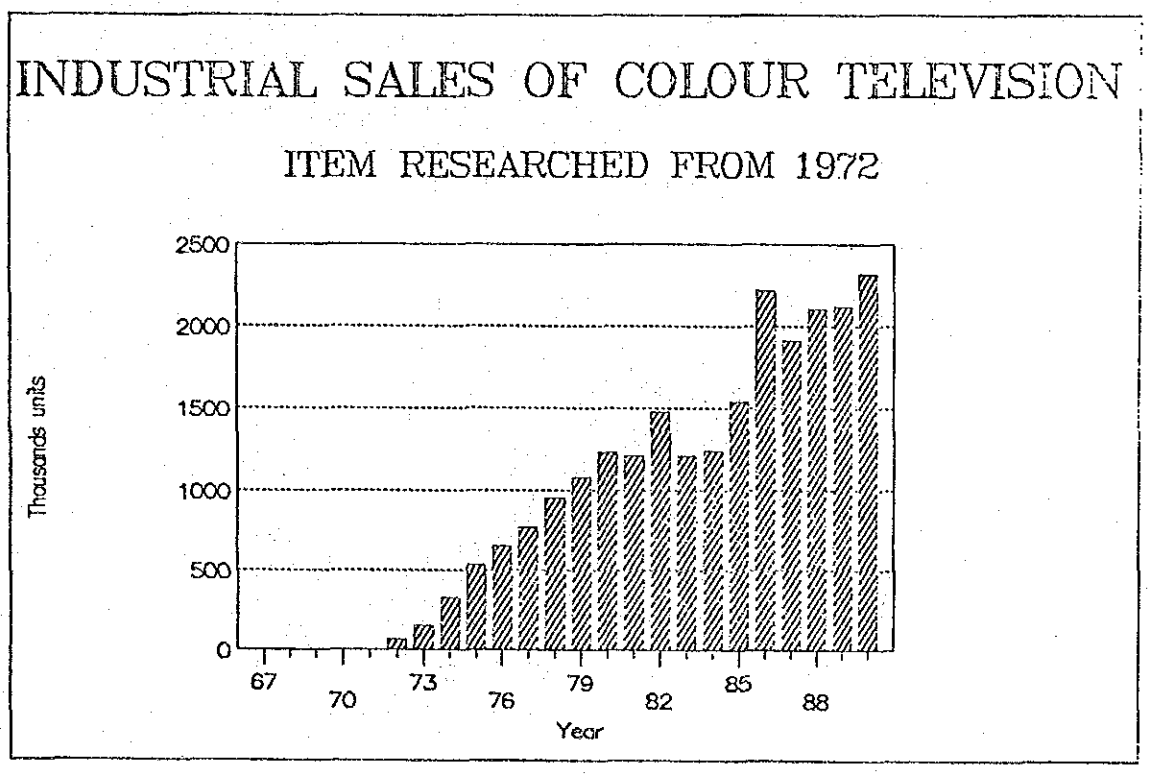
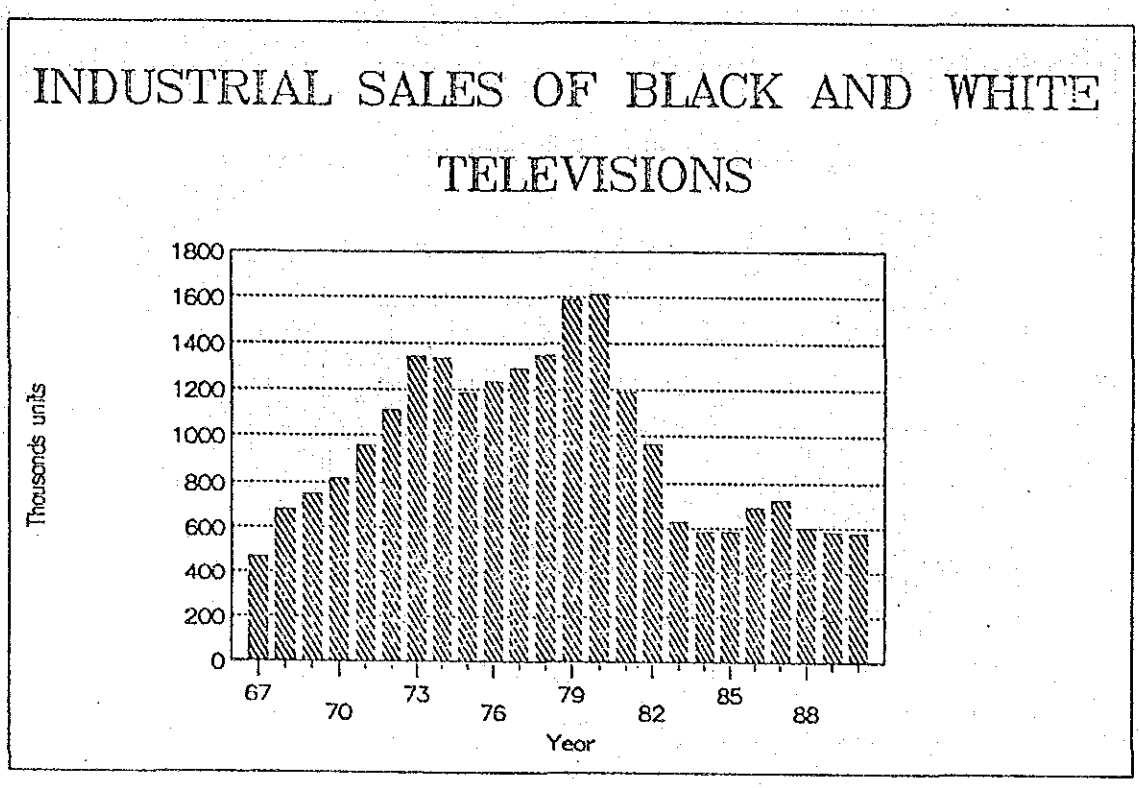
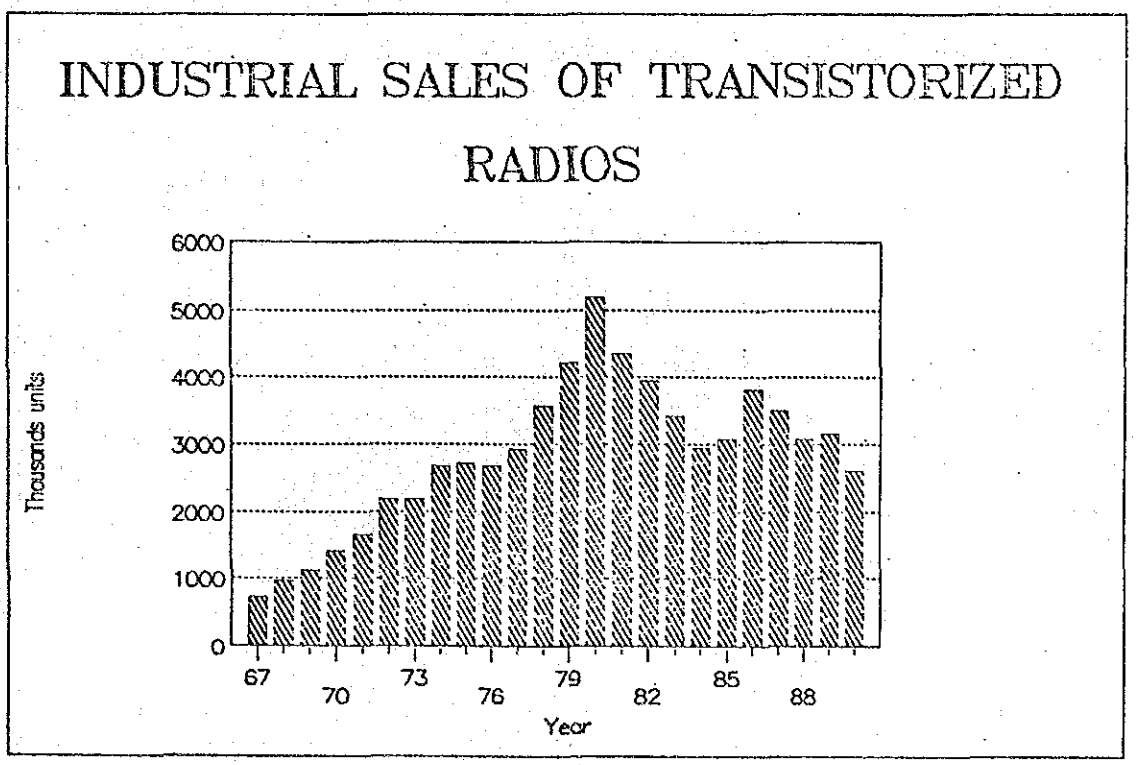
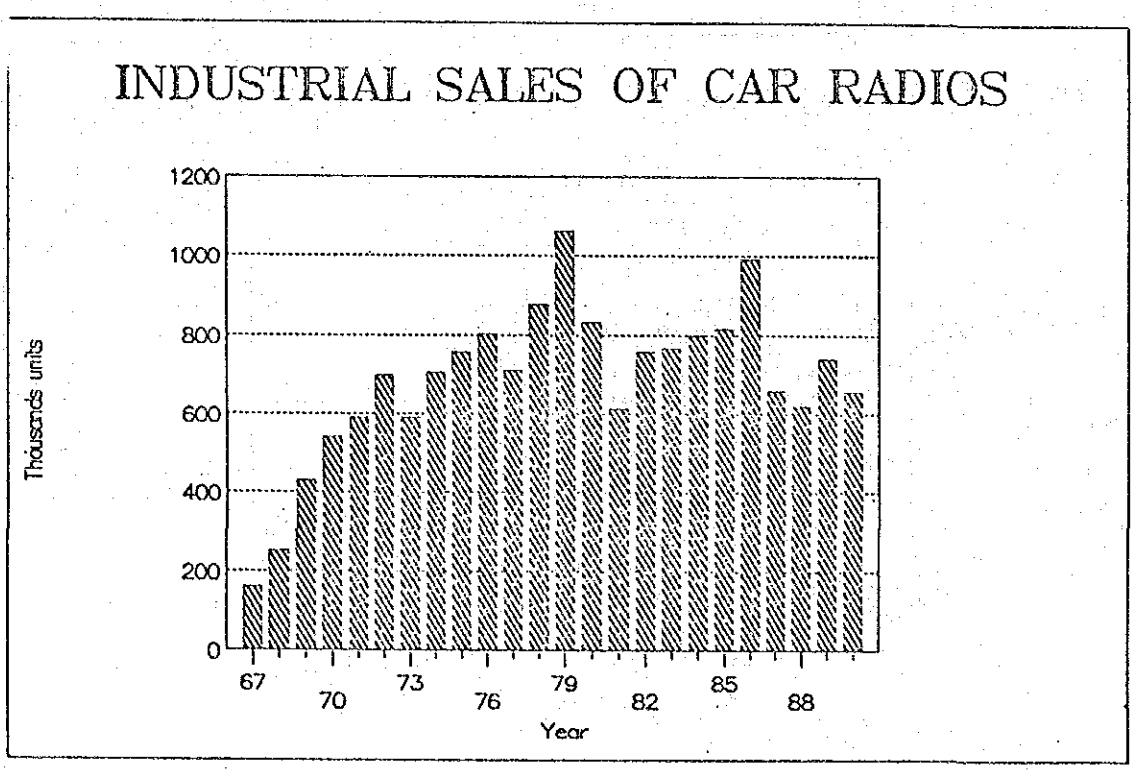
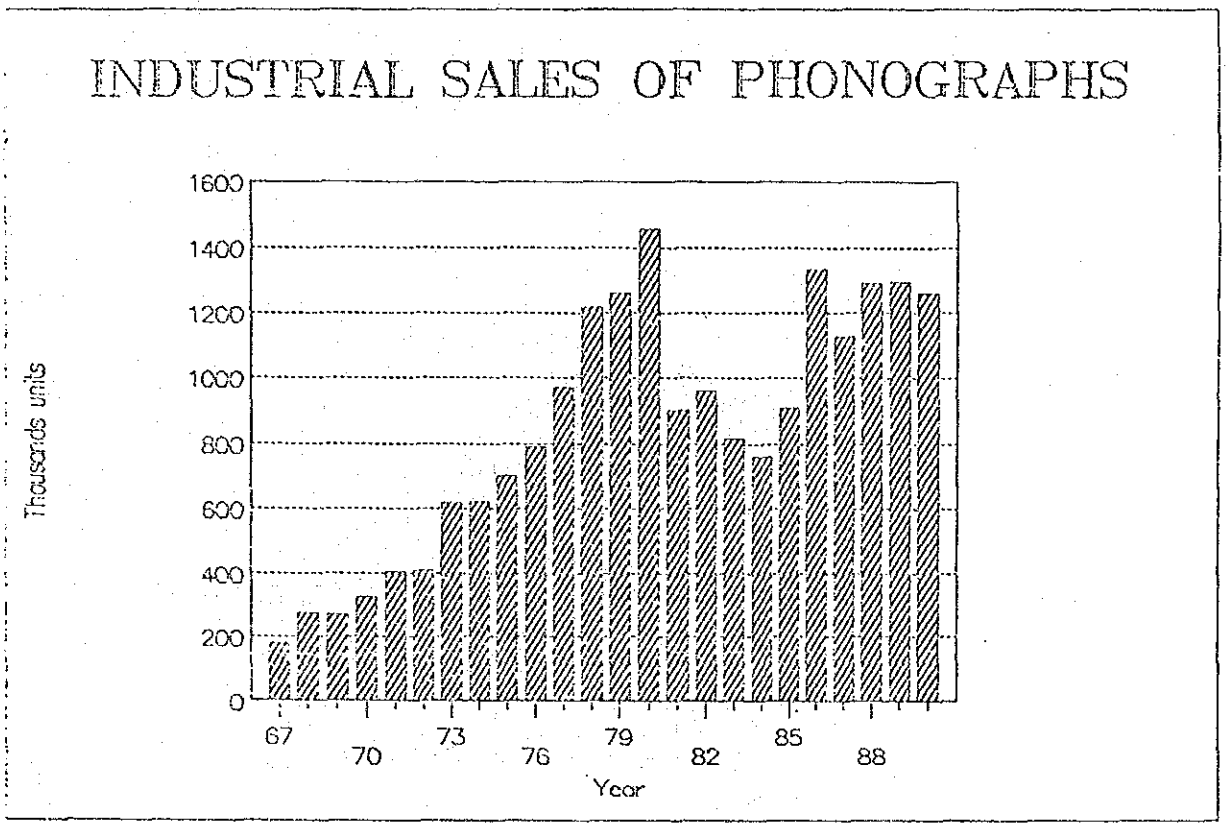
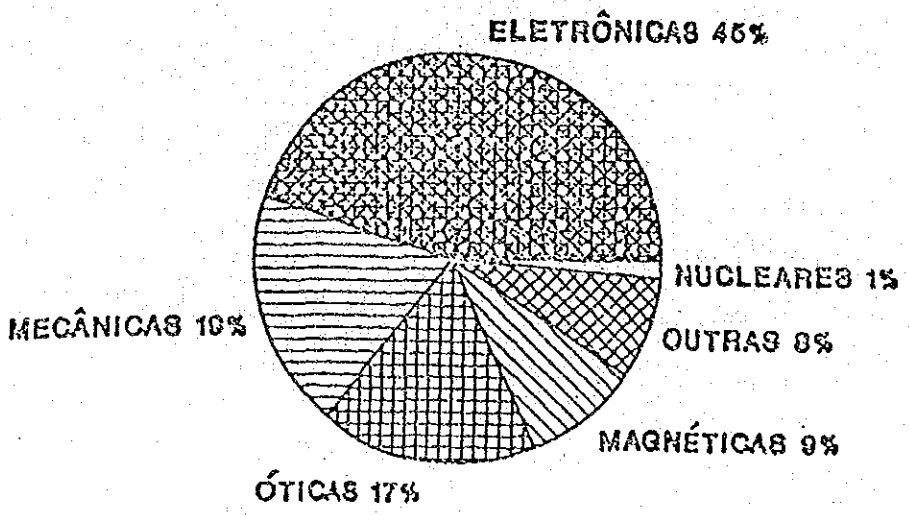

INDUSTRIAL SALES OF COLOUR TELEVISION
ITEM RESEARCHED FROM 1972
Thousands units
2500
2000
1500
1000
500
0
67
70
73
76
79
82
85
88
Year


INDUSTRIAL SALES OF BLACK AND WHITE TELEVISIONS
Thousands units
1800
1600
1400
1200
1000
800
600
400
200
0
67
70
73
76
79
82
85
88
Year


INDUSTRIAL SALES OF TRANSISTORIZED RADIOS
Thousands units
6000
5000
4000
3000
2000
1000
0
67
70
73
76
79
82
85
88
Year


INDUSTRIAL SALES OF CAR RADIOS
Thousands units
1200
1000
800
600
400
200
0
67
70
73
76
79
82
85
88
Year


INDUSTRIAL SALES OF PHONOGRAPHS
Thousands units
1600
1400
1200
1000
800
600
400
200
0
67
70
73
76
79
82
85
88
Year



BRAZILIAN ADVANCED CERAMICS MARKET - 1988

TABLE 1 - BRAZILIAN MARKET OF FINE CERAMIC PRODUCTS - DATA COLLECTED BY THE BRAZILIAN ASSOCIATION OF INDUSTRIAL AND TECHNOLOGICAL RESEARCH INSTITUTES - ABIPTI

CERAMIC AREA	TYPE	1989		1994		Estimated increasing rate per year (%)
		US$10⁶	%	US$10⁶	%	
Electric	Insulation	67,6	27,2	90,5	14,5	6
	Ferroelectric	28,0	11,2	58,8	9,4	16
	Semiconductor	17,0	6,8	63,1	10,1	30
	Piezoelectric	*	--	--	--	--
Magnetic	Soft ferrite	7,5	3,0	10,0	1,6	6
	Hard ferrite	15,0	6,0	26,4	4,2	12
Optical	Fiber	25,0	10,0	89,3	14,3	26
	Translucent alumina	8,5	3,4	19,4	3,1	18
	Others **	10,0	4,0	14,7	2,3	8
Mechanical	Cutting tools ***	27,3	11,0	67,9	10,8	20
	Structural	20	8,0	22,1	3,5	2
Nuclear	Fuels	3,5	1,4	15,8	2,5	35
Others	Catalyst substrate	--	--	110,0	17,6	--
	Others ****	20	8,0	38,0	6,1	14
TOTAL		249,4	100,0	626,0	100,0	14,2

* Market not clear due to difficulties in information collection in this wide area
** Components for advanced optical equipments (laser etc.)
*** Not including silicon nitride and sialon market
**** Estimated value (catalyst for chemical industry, sensor etc.)

AVAILABLE I.P.T. EQUIPMENTS　セラミック関係

Nº	EQUIPMENT	SPECIFICATION	QUANT.	COUNTRY
1	Mechanical press	Stockes, 280-H, 100t (1979)	1	USA
2	Extrusion press	Mohr Machinery Inc., MEP7-)40000 (1978)	1	USA
3	Cold isostatic press	National Forge, 12" ID x 36" H, 30000 psi (1978)	1	USA
4	Cold isostatic press	Autoclave Engineers Inc., IP-6, 30000 psi (1978)	1	USA
5	Extruder	IPEM, capacity 5kg/h. (1976)	1	BRASIL
6	Ultrassonic machining equipment	Branson Sonic Power Co., UMT - 5 (1979)	1	USA
7	Compression and bending strenght test machine	Tinius Olsen, 2500 kg. (1978)	1	USA
8	Compression and bending strength test machine	Tinius Olsen, 100t. (1978)	1	USA
9	Barelatograph	Adamel (1976)	1	FRANCE
10	Optical microscope for reflected and trasnmited light	Zeiss, Photomikroskop III (1980)	1	GERMANY
11	Binocular microscope for reflected and transmited light	Leitz-Heerbrugg (1980)	1	SWISS
12	Fluorescence X-ray spectrometer	Rigaku, IKF4 (1973)	1	JAPAN
13	Fluorescence X-ray spectrometer	Jeol , JS 6057 (1980)	1	JAPAN
14	Optical emission spectographer	Shimadzu, CE 170 (1974)	1	JAPAN
15	Atomic absorption spectrophotometer	Shimadzu, AA 670 (1986)	1	JAPAN
16	Atomic absorption spectrophotometer	Perkin-Elmer, 305 B (1980)	1	USA
17	Plasma spectrophotometer	Shimadzu, ICPS-50 (1986)	1	JAPAN
18	UV-VIS spectrophotometer	Hitachi-139 (1972)	1	JAPAN
19	X-ray diffractometer	Rigaku, Geigerflex (1973)	1	JAPAN
20	X-ray electron microprobe	Shimadzu, EMX-SM 1974)	1	JAPAN
21	Ball mill	Gardelin, 50 l (1978)	1	BRASIL

AVAILABLE IPT EQUIPMENTS

Nº	EQUIPMENT	SPECIFICATION	QUANT.	COUNTRY
22	Ball mill	Gardelin, 45 l (1978)	1	BRASIL
23	Subsieve particle analyser	Fisher (1973)	1	USA
24	Specific area measuring equipment	GG 2000 (1976)	1	BRASIL
25	Differential thermal analyser	Shimadzu, DT-2U (1973)	1	JAPAN
26	Scanning Electron Microscope	Cambridge, Stereoscan 180 (1971)	1	ENGLAND
27	Ball mill	Gardelin, 1200 l (1978)	1	BRASIL
28	Ball mill	Gardelin, 200 l (1978)	1	BRASIL
29	Spray dryer	Gardelin, water evaporation capacity: 50 l/h (1978)	1	BRASIL
30	Electric furnace (kiln)	Harrop, NMR-BLT - 22320-3000, 1450°C (1978)	1	USA
31	Electric furnace (kiln)	ETIL, 8CL, 1250°C (1976)	5	BRASIL
32	Gas furnace (kiln)	Bickley - 5500, 1700°C (1978) Hot zone size: 800 W x 600 H x 1000 D (mm)	1	USA
33	Gas furnace (kiln)	Bickley-2320, 1700°C (1978) Hot zone size: 300 W x 200 H x 800 D (mm)	1	USA
34	Disk mill	Sturtevant (1945)	1	USA
35	Jaw crusher	BM 10 x 20 (1976)	1	BRASIL
36	Hammer mill	Renard (1982)	1	BRASIL
37	Filter press	Gardelin (1978)	1	BRASIL
38	pH-meter	Analion (1986)	1	BRASIL
39	Equipments for glass fiber fabrication	IPT (1982)	1	BRASIL
40	Day tank	IPT, 1400°C, gas-fired (1982)	1	BRASIL
41	Dilatometer	Theta (1978)	1	USA
42	Viscosimeter	Rion Co.,Ltd (1990)	1	JAPAN
43	Gás Furnace	Morishita (1990)	1	JAPAN

3.3.1 BULK CHEMISTRY CHARACTERIZATION LABORATORY (LC)

LC1	Inductively coupled plasma spectroscope or Spark source mass spectroscope
LC2	Atomic absorption spectrophotometer
LC3	Oxygen/nitrogen analyzer Carbon analyzer
LC4	UV-VIS spectrophotometer
LC5	Sample preparation (solubilization)

3.3.2 SPATIAL CHEMISTRY, PHASES AND MICROSTRUCTURE CHARACTERIZATION LABORATORY (LCPM)

LCPM 1 Scanning electron microscope (SEM) or
Electron probe microanalyzer (EPMA) equipped with image analyzer

LCPM 2 Scanning transmission electron microscope (STEM) with EDS, and EELS and image analyzer (room with special anti-vibration floor).

LCPM 3 Optical microscope
Digital microhardness tester
Refractometer
Polariscope
Image analyzer for direct microscopy and scanner for photographs

LCPM 4 Scanning laser acoustic microscope (SLAM)
Photoacoustic microscope (PAM)

LCPM 5 Fourier transform infrared spectroscope (FT-IR)

LCPM 6 X-Ray diffractometers (XRD) with accessories (phase quantification, texture analysis, phase mapping and small-angle scattering device - SAXS)

LCPM 7 Electronic spectroscope (ESCA)

LCPM 8 Metal deposition system
Ion beam etching system

LCPM 9 Photographic laboratory

3.3.3 SAMPLE PREPARATION LABORATORY (LS)

LS 1 Milling units

LS 2 Automatic surface grinders
Precision multi-cutting and grinding machine
Cylindrical grinder
Precision thin section machine

LS 3 Vacuum-impregnation apparatus (cold mounting)
Hot compression moulding apparatus
Engraver for sample marking

LS 4 Balance
Thermostatic water-bath apparatus
Ultrasonic cleaning apparatus
Oven

3.3.4 PHYSICAL CHARACTERIZATION LABORATORY (LF)

LF 1 Particle size analyzers (laser, centrifugal and X-ray)
Helium pycnometer
Mercury porosimeter
Specific area measuring equipment (BET)
Permeater

LF 2 Absorption, bulk density and porosity determination
Analytical balance
Electric heater

3.3.5 MECHANICAL CHARACTERIZATION LABORATORY (LM)

LM 1 Universal mechanical testing machine
Erosion wear testing equipment
Dynamic elastic modulus measuring equipment
Surface roughness tester
High temperature mechanical testing machine
Creep testing equipment
Measuring instruments
Oven

3.3.6 THERMAL CHARACTERIZATION LABORATORY (LT)

LT 1 Thermal property measuring equipments
(TGA, DTA, DSC, TMA)
Thermal conductivity meter
Glass thermal dilatometer

3.3.7 ELECTRICAL CHARACTERIZATION LABORATORY (LE)

LE 1 Volume resistivity
Dielectric constant
Dielectric power factor
Dielectric breakdown strength
Electro-mechanical coupling coefficient
Specific dielectric constant
Piezoelectric constant
Mechanical Q
Frequency constant

3.3.8 *RHEOLOGICAL CHARACTERIZATION LABORATORY (LR)*

LR 1 Zeta potential analyzer
Programmable viscometer model DVIII Brookfield with thermostatic water-bath
Ultrasonic dispersion equipment
Mechanical dispersion equipment
Automatic pipets or burets
pHmeter for suspensions
Balance

3.3.9 POWDER SYNTHESIS LABORATORY (LPS)

LPS 1 Oxide powders synthesis equipment

LPS 2 Non-oxide powders synthesis equipment

3.3.10 RESEARCH EXPERIMENTS LABORATORY (LRE)

LRE 1 Ball mill
Attritor
Jet mill with classifier

LRE 2 Ball mill
Mixer
Spray dryer

LRE 3 Slip casting (ball mill, mixer and oven)

LRE 4 Ball mill
Mixer
Doctor Blade machine

LRE 5 Hot mixer
Granulator
Injection molding machine
Dewaxing furnace
Uniaxial press
Cold isostatic press
Hot press
Controlled atmosphere furnace
Electric furnaces to 1700°C
Sintering furnace for PZT
Sintering furnace for translucent alumina in hydrogen atmosphere

LRE 6 Equipment to produce monocrystal

LRE 7 Glass fusion furnace
Electric furnace for thermal treatment
High temperature viscometer
Glass annealing furnace
Quartz melting furnace

EDUCATION CENTERS FOR CERAMICS

PROFESSIONAL TECHNIC SCHOOL - COURSE ON CERAMICS

ESCOLA SENAI MARIO AMATO
(NATIONAL INDUSTRIAL SERVICE - MARIO AMATO SCHOOL)
SAO BERNARDO, SAO PAULO

CENTRO CERAMICO TIJUCAS - SENAI
(TIJUCAS CERAMICS CENTER - NATIONAL INDUSTRIAL SERVICE)
TIJUCAS, SANTA CATARINA.

GRADUATE AND UNDERGRADUATE SCHOOL (UNIVERSITY)

UNIVERSIDADE FEDERAL DE SAO CARLOS - SAO PAULO STATE

UNIVERSIDADE FEDERAL DE CAMPINA GRANDE - PARAIBA STATE

UNIVERSIDADE ESTADUAL DE PONTA GROSSA - PARANA STATE

MAIN BRAZILIAN RESEARCH INSTITUTIONS ON CERAMICS

- INSTITUTO DE PESQUISAS TECNOLOGICAS DO ESTADO DE SAO PAULO - IPT - SAO PAULO CITY
  (SAO PAULO INSTITUTE FOR TECHNOLOGICAL RESEARCH)

- INSTITUTO NACIONAL DE TECNOLOGIA - INT - RIO DE JANEIRO
  (NATIONAL TECHNOLOGICAL INSTITUTE)

- INSTITUTO DE PESQUISAS ENERGETICAS E NUCLEARES - IPEN - SAO PAULO - CITY
  (INSTITUTE FOR ENERGETIC AND NUCLEAR RESEARCH)

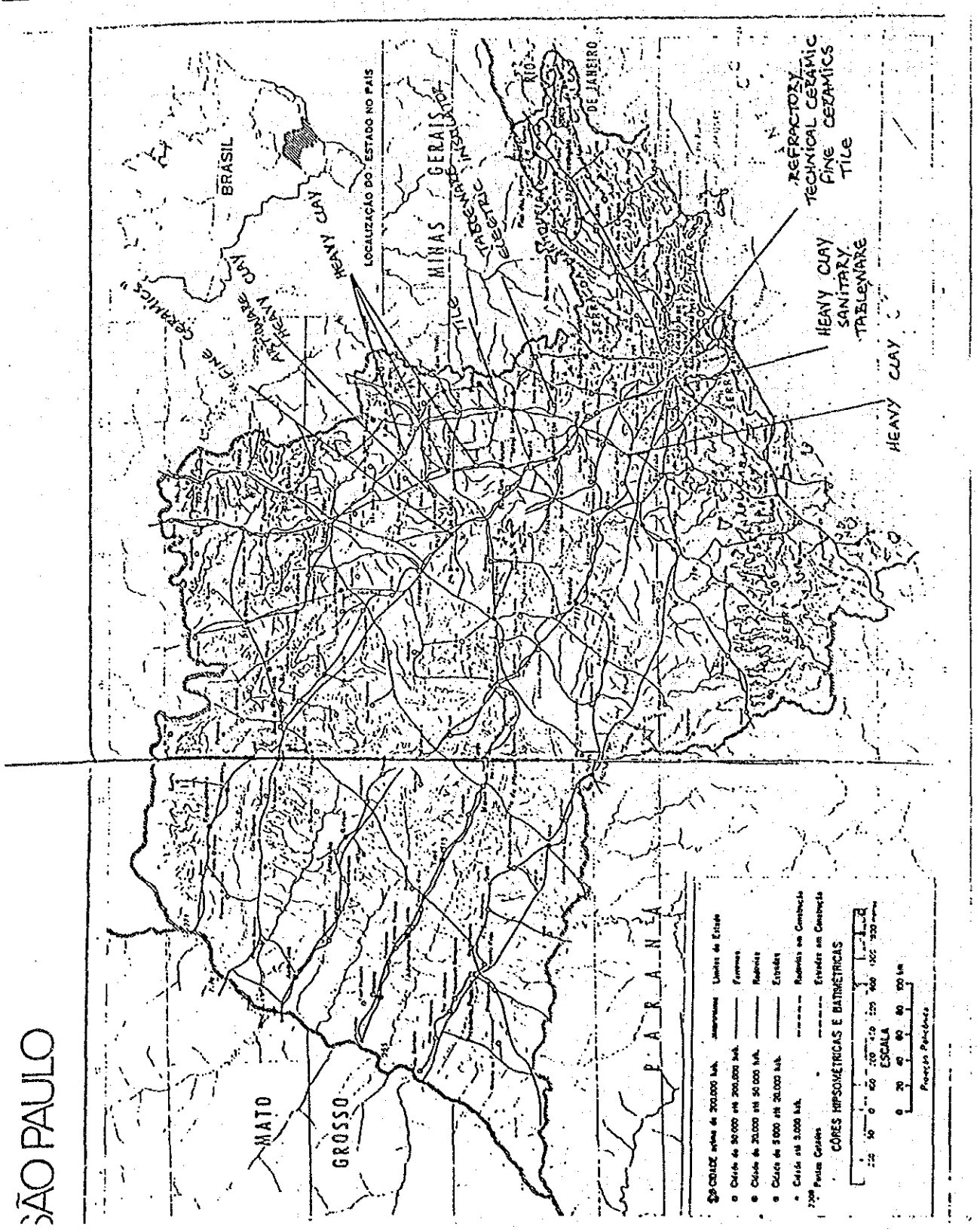
- CENTRO TECNICO AEROESPACIAL - CTA - SAO JOSE DOS CAMPOS
  (AERO SPATIAL TECHNICAL CENTER)

- UNIVERSIDADE FEDERAL DE SAO CARLOS - UFSCAR - SAO CARLOS
  (FEDERAL UNIVERSITY - SAO CARLOS)

- UNIVERSIDADE ESTADUAL DE SAO PAULO - UNESP - SAO CARLOS
  (SAO PAULO STATE UNIVERSITY - SAO CARLOS CAMPUS)

TRADITIONAL CERAMICS

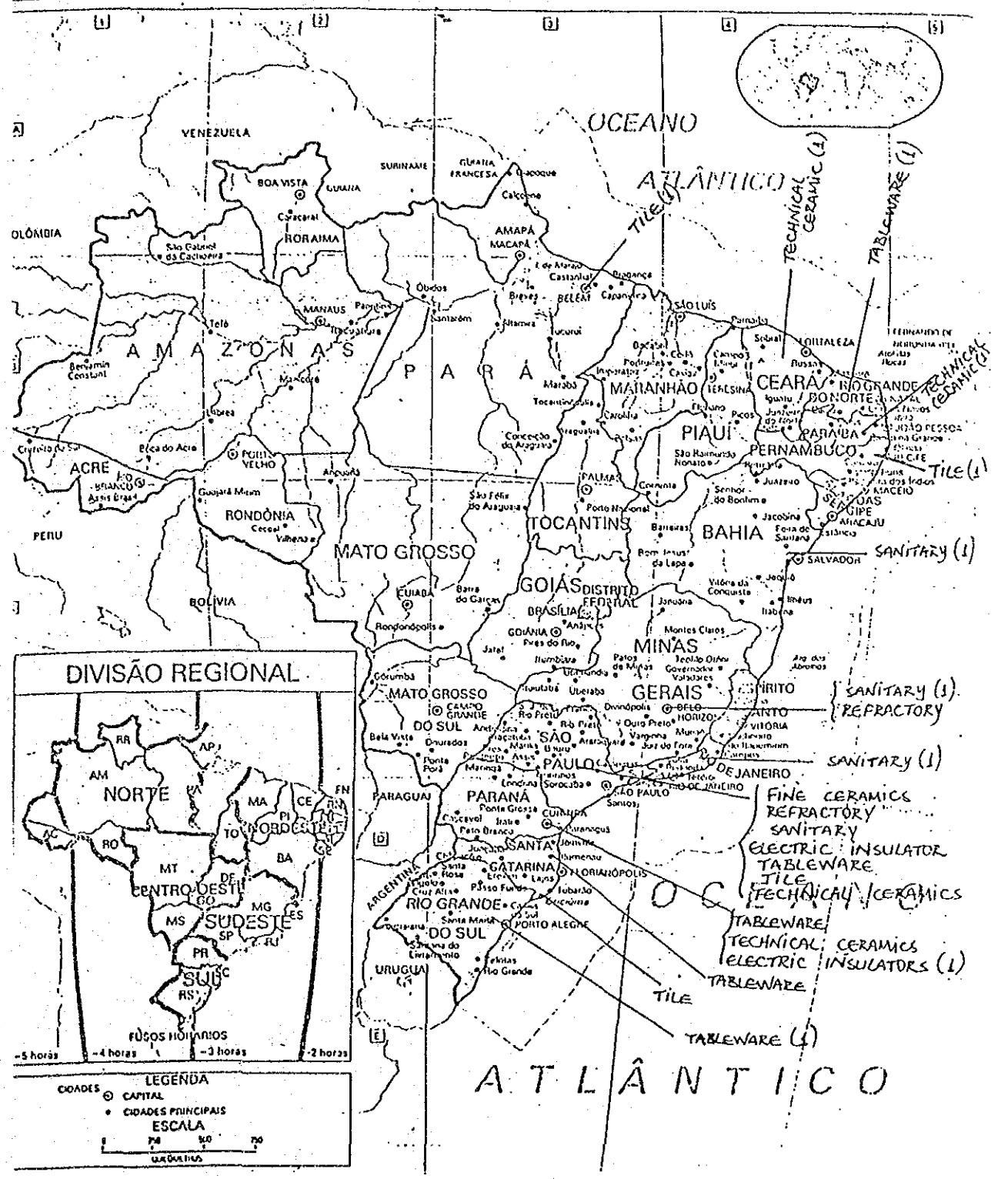
TYPE OF INDUSTRY	NUMBER
REFRACTORIES	42
SANITARY	11
ELECTRICAL INSULATORS	7
WALL AND FLOOR TILE	110
TABLEWARE AND ARTWARE	600
TECHNICAL CERAMIC PARTS OF PORCELAIN, CORDIERITE AND STEATITE FOR DIFFERENT APPLICATIONS	20
HEAVY CLAY	10000


SÃO PAULO
MATO
GROSSO
PARANÁ
MINAS GERAIS
BRASIL
RIO DE JANEIRO
LOCALIZAÇÃO DO ESTADO NO PAÍS
HEAVY CLAY
TILE
REFRACTORY
TECHNICAL CERAMIC
FINE CERAMICS
TILE
HEAVY CLAY
SANITARY
TABLEWARE
HEAVY CLAY
CÔRES HIPSOMÉTRICAS E BATIMÉTRICAS
ESCALA
Projeção Policônica

IPT

Instituto de Pesquisas Tecnológicas

BRASIL POLÍTICO



IPT CERAMICS LABORATORY

WORKING TEAM

RESEARCHERS	11
SUPPORTING TEAM	7

IPT CERAMICS LABORATORY

MAIN CLASSES OF MATERIALS

RAW MATERIALS CHARACTERIZATION

DEVELOPMENT AND CHARACTERIZATION OF THE FOLLOWING CERAMIC TYPES:

- HEAVY CLAY MATERIALS
- REFRACTORIES
- WHITE WARE
- THERMAL INSULATORS (REFRACTORY, VERMICULITE, CALCIUM SILICATE)
- HIGH ALUMINA BODIES

IPT CERAMICS LABORATORY

MAIN FIELDS OF ACTIVITY

- CHARACTERIZATION TESTS
- PRODUCTS DEVELOPMENT
- TECHNOLOGICAL ASSISTANCE TO INDUSTRIES
- TESTS NORMALIZATION
- TECHNOLOGICAL RESEARCH
- SERVICES AT THE PILOT PLANT (MILLING, SPRAY DRYING, UNIAXIAL AND ISOSTATIC PRESSING, BORING OF PIECES, HIDROCYCLONING OF RAW MATERIALS)
- TRAINING OF RESEARCHERS (COURSES AND LABORATORY WORK).

IPT CERAMICS LABORATORY

REGIONAL CERAMICS LABORATORIES - SET UP BY IPT IN COOPERATION WITH LOCAL INDUSTRIES

ITU - SAO PAULO

LABORATORY FOR TECHNOLOGICAL TESTS ON RAW MATERIALS (CLAYS) AND HEAVY CLAY PRODUCTS.

PORTO FERREIRA - SAO PAULO

LABORATORY FOR TECHNOLOGICAL TESTS ON RAW MATERIALS AND PRODUCTS (HEAVY CLAY AND WHITEWARE) (IN PHASE OF IMPLEMENTATION).

TEAM'S EXPERIENCE

THE TEAM OF IPT HAS A GOOD EXPERIENCE IN THE FOLLOWING ANALITICAL TECHNICS RELATED TO THIS PROJECT:

- CHEMICAL ANALYSIS BY:

  PLASMA SPECTROPHOTOMETER (SEQUENTIAL)
  ATOMIC ABSORPTION SPECTROPHOTOMETER
  OXYGEN/NITROGEN ANALYSER
  CARBON ANALYSER
  UV - VIS SPECTROPHOTOMETER

- MICROSTRUCTURAL AND PHASES ANALYSIS BY:

  SCANNING ELECTRON MICROSCOPE
  ELECTRON PROBE MICROANALYSER
  X-RAY DIFFRACTOMETER
  OPTICAL MICROSCOPE

- PARTICLE SIZE ANALYSIS BY ANDREASEN PIPET

- SPECIFIC AREA MEASURING (BET)

- ABSORPTION, BULK DENSITY AND POROSITY DETERMINATION BY IMERSION METHOD

- COMPRESSIVE AND FLEXURAL STRENGH TESTS

- DIFFERENTIAL THERMAL ANALYSIS

- THERMAL EXPANSION DETERMINATION

- VISCOSITY MEASUREMENT

JICA