



CRC

for

Premium

Quality

Wool

Competing Fibres

Produced for the CRC for Premium Quality Wool undergraduate program by;
Dr. Peter Auer, The University of New South Wales.



Fibre Classification

- **Natural**
 - wool
 - cotton
 - jute
 - silk, cashmere (very small markets)
- **Regenerated, Cellulosic**
 - cellulose raw material
 - rayons
 - ~1900
- **Synthetic**
 - polyester
 - 1940
 - polyamide
 - “nylon”
 - 1939
 - polyacrylonitrile
 - “acrylic”
 - 1942
 - polypropylene
 - 1960

CRC

for

Premium

Quality

Wool



Comparison of Wool & other Apparel Fibres

Property	Wool	Cotton	Polyester	Polyamide (Nylon)	Poly-acrylonitrile (Acrylic)
Diameter μm decitex	~13-30	N/A	~9	~9	N/A
	~3 - 6	~1-3	down to 1	down to 1	~3
Fibre Length (mm)	>27 (worsted)	20-35 (short staple)	to order	to order	to order
Fibre Length Variation (CV%)	50-60	~40 (natural)	~10 (to order)	~10	~10
Fibre Density (g/cm) (@ 65% R.H.)	1.31	1.52	1.39	1.14	1.19
Fibre Strength (N/dtex)	1-1.5	2 - 5	~5 (staple)	~4 (staple)	~3
Elongation at Break (%)	30-40	6 - 7	~40	~40	~25
Moisture Regain (%) (@ room temp)	13	7	1.5	4.5	1.5

CRC
for
Premium
Quality
Wool



Comparison of Wool & other Apparel Fibres

Property	Wool	Cotton	Polyester	Polyamide (Nylon)	Poly-acrylonitrile (Acrylic)
Initial Tensile Modulus (N/dtex)	~25	~50	~90	~10	~60
Elastic Recovery (%) (from 5% extension 60%r.h.)	69	52	65	89	50
<i>Features</i> Surface Longitudinal X - section	scales	smooth	variable	smooth	smooth
	crimped	convoluted	textured	textured	textured
	ovoid	flat,tubular	variable	variable	dog-bone
Heat Evolved (cal/g) (40-70r.h.) (20°C)	38	20	1	10	1
Dyeing Behaviour	easy	easy	difficult	easy	easy
Setting Behaviour	Yes	No	Yes	Yes	Yes
Felting Behaviour	Yes	marginal	No	No	No

CRC
for
Premium
Quality
Wool



Fibre Properties

- **wool is:**
 - relatively coarse
 - relatively weak but good elongation
 - relatively pliable
 - absorbs moisture well
 - gives off heat when absorbing moisture
 - finishes well (can be set)
 - subject to shrinkage (can be rectified)
- **ALSO**
 - lustrous
 - unique handle properties

CRC

for

Premium

Quality

Wool



Desirable Properties

- **fashion**
 - drape, handle, lustre (second to none)
- **performance**
 - ease of production, ease of processing, durability, strength
- **versatility**
 - linear density range, fibre characteristics, product development
- **environmental impact**
 - energy consumption, impact of production, use of raw materials, animal husbandry
- **relative cost?**

CRC

for

Premium

Quality

Wool



Fibre Costs - 1995

Fibre	Price (\$US per kg)
Wool, greasy	\$ 3.96
Wool, scoured	\$ 5.80*
Wool, top	\$ 8.40* (21µm)
Polyester, staple	\$ 1.80
Polyester, filament	\$ 2.10
Acrylic	\$ 2.20
Rayon, staple	\$ 2.60
Cotton	\$ 1.70

CRC

for

Premium

Quality

Wool

Peter Auer

Source: World Textile Demand (Oct 1996)

* CRC for PQW Wool Marketing, Lecture 8, Ross Griffith (1996)



Fibre Production

	wool	cotton	synthetic	regenerated
Raw material	amino acids	carbohydrates	petroleum by-products	Natural cellulose
Polymer production	biosynthesis	biosynthesis	Synthetic polymerisation	N/A (some modification)
Production unit	skin follicle	plant boll	factory spinneret	factory spinneret
Usable form	staple	staple	filament staple tow	filament staple tow

CRC

for
Premium
Quality
Wool



Nylon Fibre Manufacture

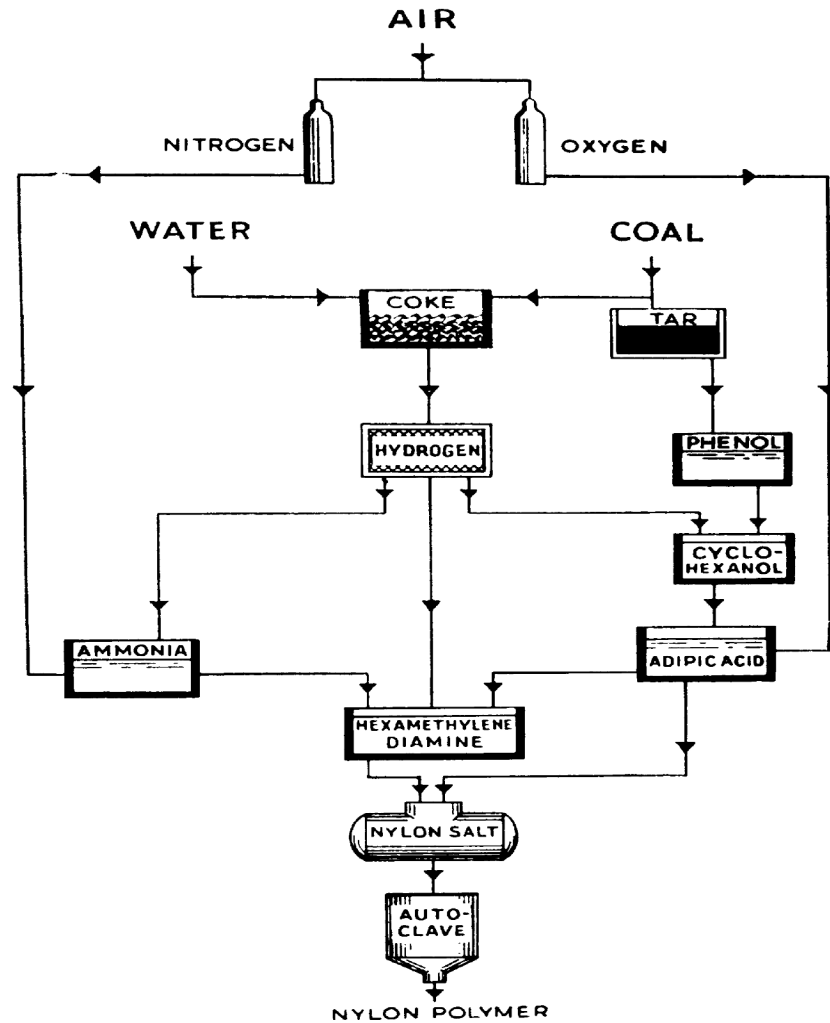


Fig. 2. Manufacture of nylon-66 polymer. (Courtesy Carroll-Porczynski.)

CRC
for
Premium
Quality
Wool

Polyester Fibre Manufacture

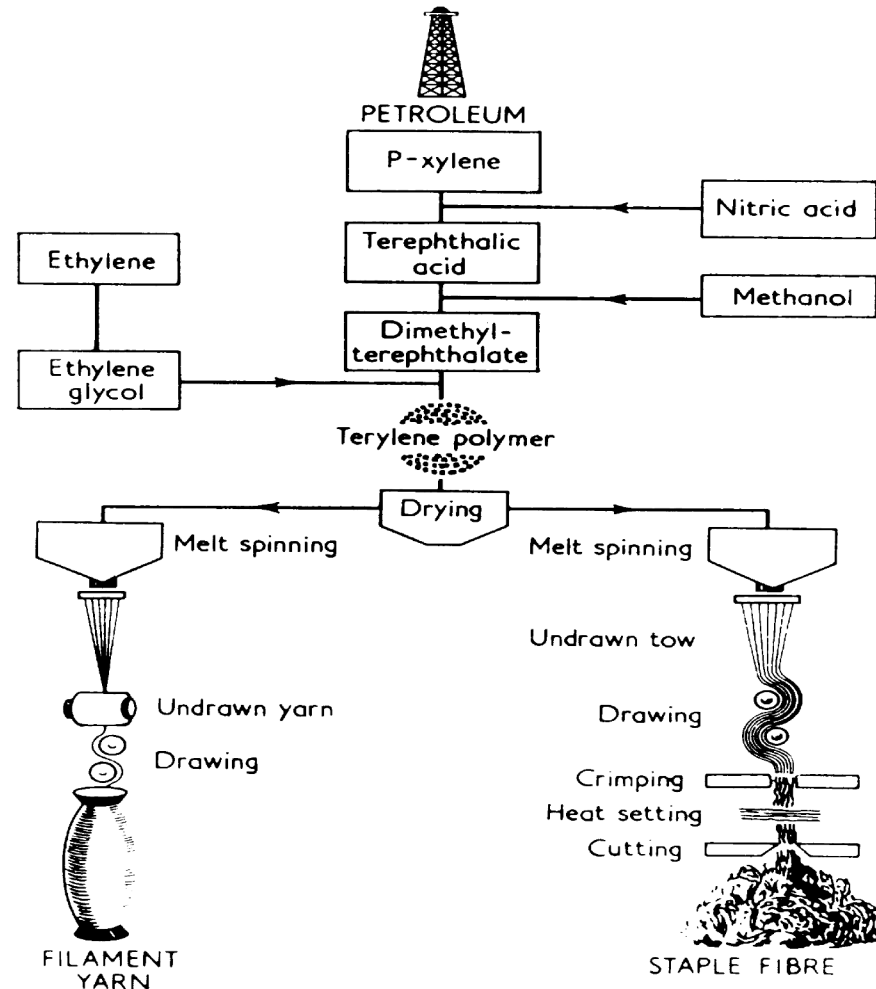


Fig. 3. Schematic diagram for the manufacture of Terylene (melt spinning). Terylene, polyethylene terephthalate fiber, is made from a polymer derived from terephthalic acid and ethylene glycol, which is melt spun and cold drawn. (Courtesy Carroll-Porczynski.)



Acrylic Fibre Manufacture

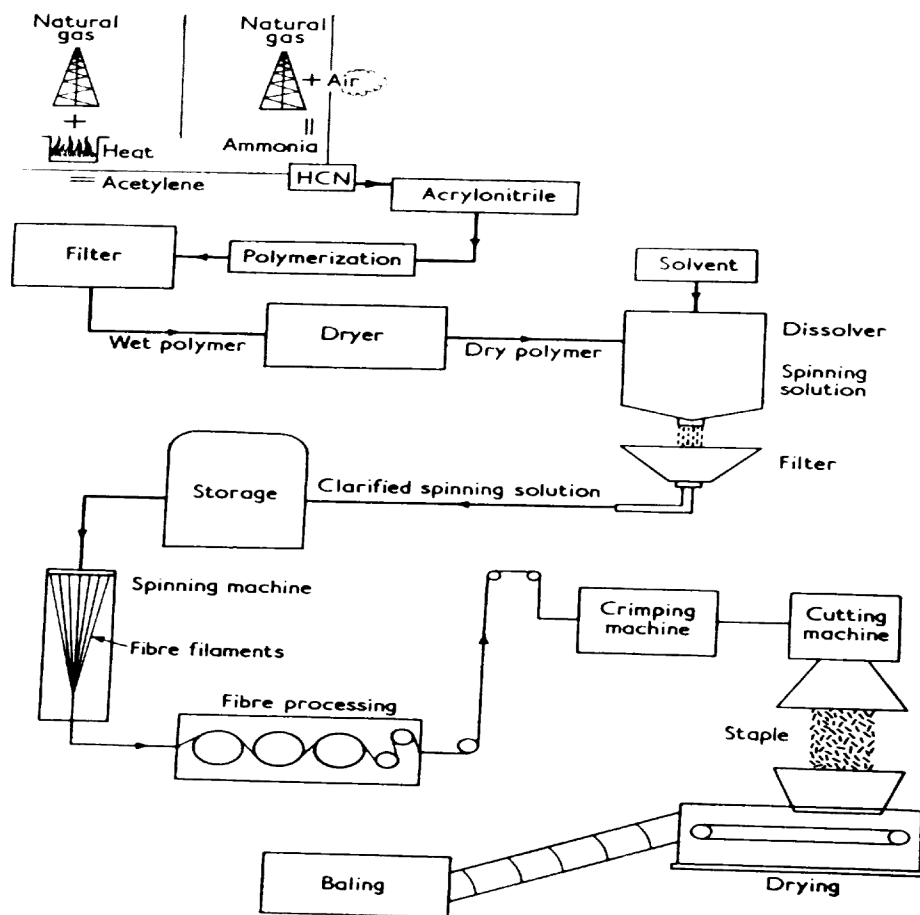
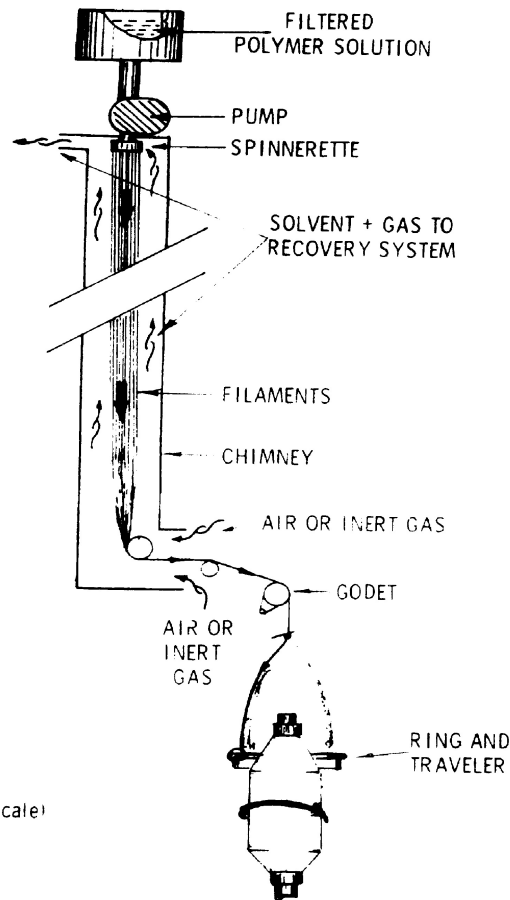


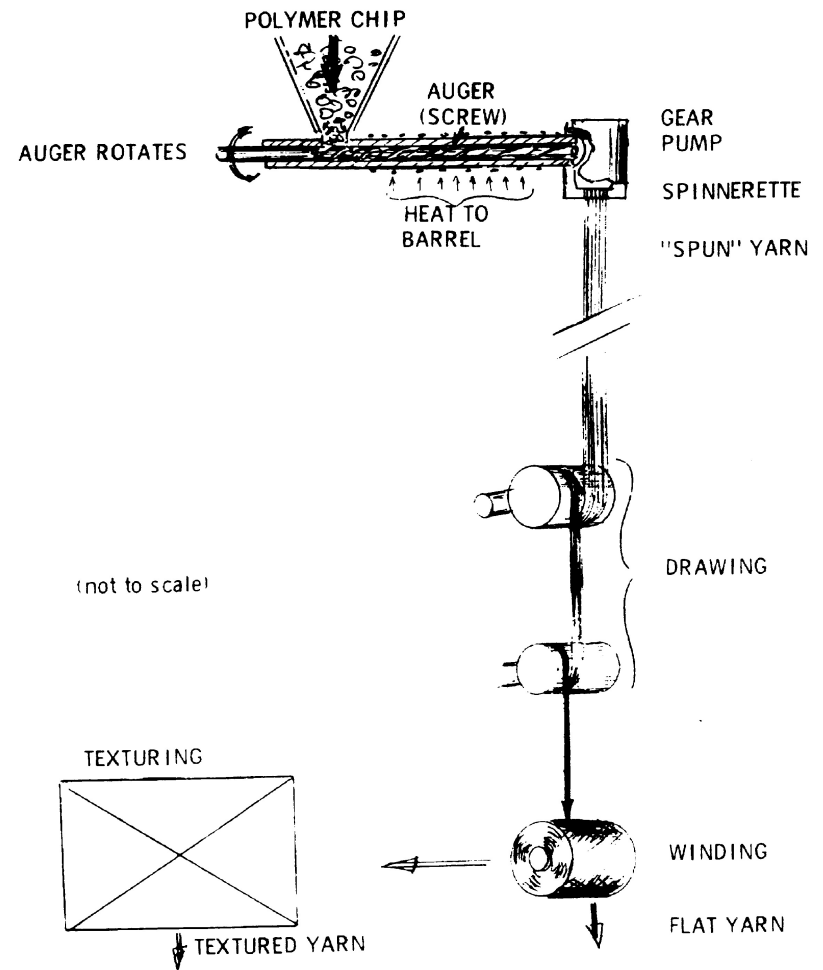
Fig. 4. Flow sheet for the manufacture of acrylic fibers. Acrylic fibers can be wet spun by extrusion into a coagulating bath containing, for example, glycerol, or dry spun by using a solvent such as dimethyl formamide. (Courtesy Carroll-Porczynski.)



Synthetic Fibre Technology



DRY Spinning



MELT Spinning



Synthetic Fibre Development

- **linear density**
 - microfibres
- **profiles**
 - Coolmax™
- **surface effects**
 - delustered
- **latent effects**
 - heat shrink acrylic
- **crimp**
 - bicomponent fibre
 - Tactel™
 - texturing
- **new chemistry**
 - PP
 - 1960
- **re-launch old chemistry**
 - Tencel™
- **length**
 - continuous filament
 - tow cutting
 - stretch breaking

CRC

for

Premium

Quality

Wool



Cotton Fibre Technology

- metrology
 - HVI
 - every lot is tested
 - linear density
 - length
 - strength
 - trash
 - main price determinants
 - market confidence
- crop types
 - GM crops
 - higher yields
- ginning
 - process control
 - IntelligenTM
 - trash content can be adjusted to suit market
- processing developments
 - U.S.

CRC

for

Premium

Quality

Wool



Wool Fibre Technology

- **Wool**

- **finishing**

- shrink-resist fibres
 - machine washable
 - insect-proof fibres
 - flame-proof fibres
 - safety
 - enzyme treatment
 - prickle

- **blending**

- new specs
 - fibre diameter
 - length
 - crimp

- **Optim™ fine**

- linear density
 - profiles
 - surface effects

- **Optim™ max**

- latent effects

- **processing**

- spinning
 - easy care
 - fibre blends
 - wool/microfibre

CRC

for

Premium

Quality

Wool