ALEXANDRA PALACE - STUDIO 'A'

CAMERA SCRIPT

RECORDING No: VTM/6LT/70119

O.U.REF.No.: S.100/13

Monday, 26th October, 1970.

PROJECT NO.: 00520/1113

OPEN UNIVERSITY SCIENCE COURSE UNIT 13

EXECUTIVE PRODUCER......NAT TAYLOR
DIRECTOR................BARRIE WHATLEY
ASSISTANT...............ANNE F. HAIGH
DESIGNER................RICHARD MORRIS
FLOOR MANAGER...........ROGER BAMFORD
T.M.1...................PETER MURRAY
SOUND SUPERVISOR........JERRY LAWRENCE
VISION MIXER............ROGER SUTTON
CAMERA CREW.............'AP' CREW
SEN.CAMERAMAN...........GORDON BLOCKLEY
CO-ORDINATING PRODUCER..JAMES McCLOY

...

TAKING PART

PROFESSOR M. PENTZ
PROFESSOR L.J. HAYNES
DR. R. HILL

RECORDING SCHEDULE

CAMERA REHEARSAL.............1030/1300
LUNCH........................1300/1400
CAMERA REHEARSAL.............1400/1530
LINE-UP......................1530/1600
RECORDING & TK INSERT........1600/1715

...

VT CLOCK ON 4

F/U

1. TJ Slide I
   'Science - A Foundation Course'

2. TJ Slide 2
   Course Unit 13

3. TJ Slide 3
   Introduced by.....

4. 2A
   MS Pentz (Seated)

BOOM A

Q PENTZ

PENTZ: Intro.....

......and then we'll consider how some of the physical properties of polymers can be explained from a knowledge of their structure. Professor Haynes........

(Cam.3 next..Shot 5)

5. 3A

MS Haynes

/ BOOM B /

HAYNES: The modern chemical industry......

/ 2 to B /

....I'll concentrate first on Addition Polymers. Let's work at some of the monomers from which the common addition polymers are made.

6. 4A

(ANIMATION 1)

This is 'ethylene' - the monomer of polyethylene - polythene,

- vinyl chloride -
- propylene -
- methylmethacrylate -
- styrene -

....which you'll probably be more familiar with, in its expanded form, as ceiling tiles.

(3A next..Shot 7)

..3/

7.	3A	HAYNES:
	Haynes with Molecular model 1. INTERCUTTING with 1 (Cam.1A CU model 1)	Clearly they all contain a carbon-carbon double bond, and it is the conversion of this double bond to two single bonds which are used to form the links of the polymer chain that is the basis of Addition Polymerisation.
	(Cam.1 LS Bench & Leslie)	(TURNS TO BENCH, REFERS TO LESLIE, TAKES TUBE)
	(Cam.1A CU Tube)	In this tube I have 2.5. dichlorostyrene which is very similar to the monomer for polystyrene.
8.	4A	(ANIMATION 1 cont'd)
	INTERCUTTING: Cam.1A CU Tube	(Adds initiator - mixes with spatula, puts down tube...picks up initiator bottle).
	/1 to 1B/	HAYNES: This is called a free radical initiator and here's Dr. Hill to tell you how it works

(2B next...Shot 9)

..4/

9. 2B — HILL: [BOOM A]

M.LS Hill r.h.s. of photomix

The free radicals in the addition polymerisation initiator are created by the break-down of weak co-valent bonds in certain molecules such as peroxides.

10. 1B — PHOTOMIX SEQUENCE 1

Photomix

(Slides 1 - 10 on Q)

(Hill explains polymerisation mechanism)

11. 4A — ANIMATION 2

Pan slowly L - R

.....but eventually it stops.

12. 2B — HILL:

M.CU Hill

Why is this? Well, there are several mechanisms by which the chain propagation can be stopped and you'll find them in the text, but I'll just consider one for now.

(4A next...Shot 13)

13. 4A (ANIMATION 2)

(Animate on Q)

......polymer no longer has any free electrons so cannot be further lengthened - the chain has been stopped.

(COMING TO 2)

14. 2B HILL: (shows the links of the polymer are not straight, but that it can be regarded as one dimensional)

MS Hill & Molecular model 2

INTERCUTTING:
Cam.1 CU Model

/ 1 --- 4A /

....Polymer chains sometimes contain as many as 5000 monomer units.

15. 3A HAYNES: / BOOM B /

MS Haynes

(Moves to polymer experiment then leaves..)

Dr. Hill just mentioned that some polymer chains contain up to 5000 monomer units.

INTERCUTTING:
Cam.1 B.CU string between fingers

(Picks up string - holds small end between finger & thumb... pulls up rest of string.)

...as you can see our polymer molecule is essentially one dimensional. (cont'd)

(2B next...Shot 16)

cont'd..6/

15. 3A (CONT'D) | HAYNES (cont'd)

Cam.1 CU Tube

(Turns to bench..picks up polymer & tube by spatula)

/ 1 --- B /

(Summary section:- consider condensation polymers)

...In the formation of this type of polymer - when the monomers link together to form a chain, for each link that is formed, a small molecule such as water or hydrogenchloride is also formed.

/ BOOM A /

16. 2B | HILL:

MS Hill

The amino acids we talked about in CU:10 can condense together to form a polymer - the protein molecule.

17. 1B

Photomix

(PHOTOMIX SEQUENCE 2)

(Slides 11 - 16 on Q)

(Explains process of condensation polymerisation for protein & nylon....show on photomix)

...This sort of polyamide is the type found in the nylons, where A and B can be anyone of a number of carbon frameworks.

(3A next...Shot 18)

/ BOOM B /

...7/

18. 3A

MS Haynes

/ 1 --- A /

INTERCUTTING:
Cam.1 B.CU Individual beads

HAYNES:

So in the formation of condensation polymers no initiator is required, but during the formation of the linking bond a small molecule - like water - is also formed.

(PICKS UP BEADS & SHOWS TWO FORMS OF POLYMER CHAIN)

...series of condensation polymers and a little later on we'll look at another, 'Terylene', which is a polyester.

(TURNS TO BENCH..NYLON EXP.)

Here we have the two components of a condensation polymer of the nylon type.

19. 4A Caption 1.

CAPTION 1

They are.......

....You see, we are using an acid chloride. This is because it reacts more quickly. So the molecule eliminated will be hydrogen chloride and not water.

(3B next...Shot 20)

...8/

20. 3B ______________________ (NYLON EXPERIMENT)

M.LS Haynes & Leslie

INTERCUTTING:
Cam.1 CU Beaker holding
2 liquids layers

....Although condensation and addition polymers are formed in different ways this does not necessarily give them different physical properties. It is the structure of the individual polymer chains and their relation to one another which has the greatest effect on the physical properties.

(EXPERIMENT..FORMATION OF FIBRES)

Cam.1 CU Fibres &
2 glass dishes

...why is it that the nylon fibre is so strong.

(HAYNES PICKS UP BEADS AND DEMONSTRATES HOW CHAINS ALINE - REF. TO SPECIAL INTER CHAIN BONDING)

...Then compare your ideas with the explanation in the text.

(PICKS UP SAMPLES)

...These are two samples of poly-propylene - the addition polymer made from propylene.

(4A next..Shot 21)

..9/

21. 4A (ANIMATION 1)
(Propylene)

22. 3A (reason for difference in properties is explained by structure)
MS Haynes

Cam.1 CU models

(MOVES TO MOLECULAR MODELS (3) & DEMONSTRATES - REGULAR - IRREGULAR STRUCTURES)

/ 1 to A /

....The use of Ziegler catalysts is an example of where a knowledge of how reactions occur allows synthesis of special structures with well-defined physical characteristics.

/ BOOM A /

23. 2B HILL:

So far only considered one dimensional polymers........

24. 1B (PHOTOMIX SEQUENCE 2 cont'd)

(Slides 17, 18, 19)

(HILL COMPARES POLYESTER - POLYAMIDES)

HILL:

...now we can form another polymer - called a glyptal resin - with these two compounds.

(4B next...shot 25)

..10/

25. 4A Caption 2 (Glyptal Resin monomers)

(GIVES 3-D STRUCTURE)

26. 1B (PHOTOMIX SLIDE 20)

HILL:

...comparison with terylene shows that it is a polyester containing exactly the same type of units, but what effect does it's 3-D structure have.

/ BOOM B /

27. 3A
MS Haynes

/ 1 — A /

HAYNES:

You can't really appreciate the 3-D structure of glyptal resin from a 2-D drawing, so we've made a model of it.

INTERCUTTING:
Cam.1 CU model

(MOLECULAR MODEL 4..GLYPTAL RESIN)

...the new polymer no longer forms strong fibres, but now it is extremely hard and is ideal as a hard protective coating.

Cam.1 CU Article

(ARTICLE TREATED WITH GLYPTAL RESIN)

PHENOL/FORMALDEHYDE EXPERIMENT

Cam.1 CU experiment

(4A next...shot 28)

28. 4A Caption 2 (Phenol formaldehyde)

/ STANDBY TK /

29. 3A HAYNES:

(as Shot 27)

...the process of converting a raw plastic into a useful product involves a very skilled use of advanced technology and ingenuity.

/ ROLL TK..../

---

30. TK FILM OPENING WORDS

(Duration: 3'32")

'Most crude polymers can be made in manually operated units like this....but these are now being replaced by fully automated units, where the progress of the polymerisation is regulated from a remote controlroom............

CLOSING WORDS...

...There are many processes, each is designed to make the best use of the qualities of the particular polymer so as to manufacture the product as efficiently as possible.

(STOP TK)

(2A next..shot 31)

/ BOOM A /

31. 2A

MS Pentz seated by table

INTERCUTTING:
Cam.1 CU Buttons

PENTZ:

Well, plastic soles for shoes may not seem a great advance. But, just think how the properties and adaptability of plastics have completely changed the manufacturing industry.

Take these buttons as an example they are made from mother-of-pearl and horn. They had to be individually cut, drilled and finished. Today plastics can be pressed into a completely finished button in seconds. The same applies to all the earlier manufacturing materials like whalebone, ivory, tortoiseshell and wood - they all had to be individually machined. We may not necessarily feel that the replacement of natural materials by plastics is a good thing but it is definitely here to stay.

We can only hope that in the future not only will the synthetic replacements be cheaper but that they'll also be better in every case. However, the further we move from the use of natural

cont'd..13/

31. 2A (cont'd)

PENTZ: products to the more durable synthetic polymers the greater the problem of waste disposal becomes. The plastic bag designed to shield its contents of fertilizer from all the ravages of man and nature can become a piece of virtually inde-composable rubbish. Of course, it can be burnt but first it has to be collected from the countless places where we have carelessly thrown it away. We can no longer rely on nature to remove all trace of our thoughtlessness.

32. 3A

CU Mylon Experiment

33. 4A

Caption 3 'OU Symbol'

FADE OUT 3A

S/I

34. TJ Slide

The Speakers were....

35. TJ Slide

Extracts from film...

36. TJ Slide

Production by........

37. TJ Slide

'A production for.....

T/O

FADE SOUND AND VISION.....

THE END.

S100 - 13

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   Introduced by.....

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PENTZ: Intro.....

......and then we'll consider how some of the physical properties of polymers can be explained from a knowledge of their structure. Professor Haynes........

(Cam.3 next..Shot 5)

5. 3A

MS Haynes

/ BOOM B /

/2 to B /

HAYNES: The modern chemical industry......

....I'll concentrate first on Addition Polymers. Let's work at some of the monomers from which the common addition polymers are made.

6. 4A

(ANIMATION 1)

This is 'ethylene' - the monomer of polyethylene - polythene,

A - vinyl chloride -

B - propylene -

C - methylmethacrylate -

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....which you'll probably be more familiar with, in its expanded form, as ceiling tiles.

(3A next..Shot 7)

7\. 3A — HAYNES:

Haynes with Molecular model 1.

INTERCUTTING with 1 (Cam.1A CU model 1)

Clearly they all contain a carbon-carbon double bond, and it is the conversion of this double bond to two single bonds which are used to form the links of the polymer chain that is the basis of Addition Polymerisation.

(Cam.1 LS Bench & Leslie)

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In this tube I have 2.5. dichlorostyrene which is very similar to the monomer for polystyrene.

8\. 4A — (ANIMATION 1 cont'd)

INTERCUTTING:
Cam.1A CU Tube

(Adds initiator - mixes with spatula, puts down tube...picks up initiator bottle).

/ 1 to 1B /

HAYNES: This is called a free radical initiator and here's Dr. Hill to tell you how it works

(2B next...Shot 9)

9. 2B — HILL: [BOOM A]

M.LS Hill r.h.s. of photomix

The free radicals in the addition polymerisation initiator are created by the break-down of weak co-valent bonds in certain molecules such as peroxides.

10. 1B — PHOTOMIX SEQUENCE 1

Photomix

(Slides 1 - 10 on Q)

(Hill explains polymerisation mechanism)

11. 4A — ANIMATION 2

Pan slowly L - R

.....but eventually it stops.

12. 2B — HILL:

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Why is this? Well, there are several mechanisms by which the chain propagation can be stopped and you'll find them in the text, but I'll just consider one for now.

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13. 4A (ANIMATION 2)

(Animate on Q)

......polymer no longer has any free electrons so cannot be further lengthened - the chain has been stopped.

(COMING TO 2)

14. 2B
MS Hill & Molecular model 2

INTERCUTTING:
Cam.1 CU Model

/ 1 --- 4A /

HILL: (shows the links of the polymer are not straight, but that it can be regarded as one dimensional)

....Polymer chains sometimes contain as many as 5000 monomer units.

15. 3A
MS Haynes

INTERCUTTING:
Cam.1 B.CU string between fingers

HAYNES: / BOOM B /

(Moves to polymer experiment then leaves..)

Dr. Hill just mentioned that some polymer chains contain up to 5000 monomer units.

(Picks up string - holds small end between finger & thumb... pulls up rest of string.)

...as you can see our polymer molecule is essentially one dimensional. (cont'd)

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15. 3A (CONT'D) | HAYNES (cont'd)

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(Turns to bench..picks up polymer & tube by spatula)

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(Summary section:- consider condensation polymers)

...In the formation of this type of polymer - when the monomers link together to form a chain, for each link that is formed, a small molecule such as water or hydrogenchloride is also formed.

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(Slides 11 - 16 on Q)

(Explains process of condensation polymerisation for protein & nylon....show on photomix)

...This sort of polyamide is the type found in the nylons, where A and B can be anyone of a number of carbon frameworks.

(3A next...Shot 18)

/ BOOM B /

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HAYNES:

So in the formation of condensation polymers no initiator is required, but during the formation of the linking bond a small molecule - like water - is also formed.

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(PICKS UP BEADS & SHOWS TWO FORMS OF POLYMER CHAIN)

...series of condensation polymers and a little later on we'll look at another, 'Terylene', which is a polyester.

(TURNS TO BENCH..NYLON EXP.)

Here we have the two components of a condensation polymer of the nylon type.

19. 4A Caption 1.

CAPTION 1

They are.......

....You see, we are using an acid chloride. This is because it reacts more quickly. So the molecule eliminated will be hydrogen chloride and not water.

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/ 1 to A / ....The use of Ziegler catalysts is an example of where a knowledge of how reactions occur allows synthesis of special structures with well-defined physical characteristics.

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So far only considered one dimensional polymers........

24. 1B (PHOTOMIX SEQUENCE 2 cont'd)
(Slides 17, 18, 19)
(HILL COMPARES POLYESTER - POLYAMIDES)

HILL:
...now we can form another polymer - called a glyptal resin - with these two compounds.

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(GIVES 3-D STRUCTURE)

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/ STANDBY TK /

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(as Shot 27)

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/ ROLL TK.... /

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(2A next..shot 31)

....12/

/ BOOM A /

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CU Nylon Experiment

33. 4A

Caption 3 'OU Symbol'

FADE OUT 3A

S/I

34. TJ Slide

The Speakers were....

35. TJ Slide

Extracts from film...

36. TJ Slide

Production by........

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'A production for.....

T/O

FADE SOUND AND VISION.....

THE END.