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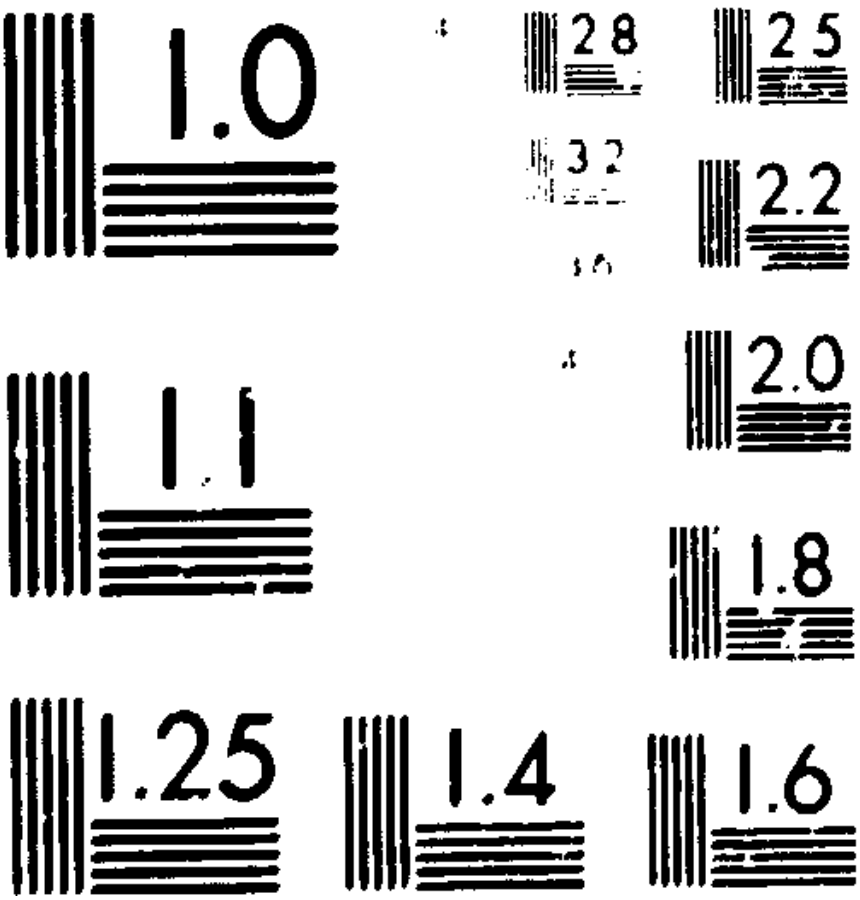

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DP/ID/SER.A/385
4 October 1982
English

KOREA DESIGN AND PACKAGING CENTER, PHASE II

DP/ROK/78/008

REPUBLIC OF KOREA

-8. [illegible]82

Technical report: Design of plastic packages*

Prepared for the Government of the Republic of Korea
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Leslie J. Buck,
consultant in the design of plastic packages

[illegible]

United Nations Industrial Development Organization
Vienna

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V.82-30944

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I. INTRODUCTION

1. Background

Under the fourth five year economic development plan, the government is continuing to place heavy emphasis on the promotion of both light and heavy industry and on the Export of industrial products.

An important requirement for increasing the marketability of local products, domestically and through export, is the continuous improvement of packaging for both presentation and handling purposes.

The Korea Design and Packaging Center (KDPC) is assisting industry to improve the design, manufacture and quality of domestic and export packaging through transfer and adaptation, where applicable, of advanced packaging technology and packaging materials together with the establishment of improved quality standards, testing methods, warehousing and physical distribution practices.

2. Job Description

DP/ROK/78/008/11-59/31.7.E

Post Title : Consultant in the design of plastics packages

Duration : Four months

Span of Employment : 27 February, 1982 to 25 June, 1982

Duty Station : Seoul, with possibility of travel within the country

Purpose of Project : The government is very much concerned with the increase of exports and substitution of imports by improving the quality and increasing the supply of nationally manufactured goods. The Korea Design and Packaging Center is expected to assist industry to improve the design and quality of packaging for multiple purposes of presentation,

protection and handling, through the transfer and adaptation of advanced packaging technologies and the establishment of quality standards and testing procedures.

Duties Reporting to the co-ordinator of UNDP's projects in the UNDP Headquarters and working in cooperation with the counterparts of the Korea Design and Packaging Center(KDPC), the expert will specifically be expected to:

a) Advise the technical and design personnel of KDPC on the various properties of materials, on appropriate applications and conversion processes of rigid and flexible plastics and laminates.

b) Assist in planning and organising the KDPC's research and development program within the field of specialisation.

c) Provide information and advice on the state of plastics packages abroad and recommend possible applications and designs suited to various export markets.

The consultant will also be expected to prepare a final report, setting out the findings of the mission and recommendations to the government on futher action which might be taken.

3. Official Arrangements

Satisfactory accommodation, office space and secretarial services were provided by both UNDP and KDPC.

4. Counterpart Staff

The counterpart is a suitable choice. He has worked hard in a very co-operative and satisfactory manner. He has a good command of written and spoken English language and has acted as a very effective interpreter. He has been able to accommodate a great deal of technical information, and should be able to produce practical benefits thereby, within KDPC and within industry after the expert has left Korea.

II. SUMMARY

Twelve companies were visited and in several cases a return visit was requested in order to obtain futher guidance as a result of benefits which had already been gained; by acting upon the initial advice given by the expert.

Technical advice was also given to four companies whose representatives visited KDPC seeking assistance.

The span of manufacturing activities covered was less than the expert had expected to cover. No visits were made to companies making rigid plastics packaging, to blow moulders or vacuum and pressure formers. Nor to plastics foam processors. This means that large areas of plastics packaging supply which are used for export goods have not received any technical help during the conduct of this mission. The reasons are threefold.

1. When the necessary time and effort which have already been expended, are taken into account, it becomes apparent that the duration of four months was too short to accomplish all that needs to be done. Therefore effort was expended in those areas which KDPC indicated as being first priority.

2. The amount of technical detail needing explanation for each company visited, and the need for that information to be translated into Hangul writing has used a larger part of the counterpart's time when at his desk in KDPC than had been envisaged by the Expert.

3. Budgetary restraints, caused by the fact that KDPC has to earn all its income without any direct government input of funds, has meant that only one counterpart could be efficiently used because the costs of utilising all of the time of more than one counterpart were/are prohibitive.

Under "Recommendations" later in this report, suggestions will be made which may alleviate some of the difficulties referred to in this summary.

Numerous in-house discussions were held with staff members of KDPC, on a wide variety of topics.

III. SUBSTANTIVE SECTIONS- ACTIVITIES AND FINDINGS

1. General Observations

Due to the limited range of companies visited, mostly engaged in converting of flexible plastics packaging and confectionery and snack foods manufacture, the detailed substantive section of this report will be rather heavily loaded towards printing, converting and laminating, and package surface design.

Other areas, such as cushioning, foams, and injection and blow moulding, will not be covered in technical detail. If more visits could have been made by the expert, the report could have been much more explicit in every area of plastics package design.

Whole industries, such as automotive spare parts, electronic components,communications equipment, Hi-Fi and TV packaging and military packaging using plastics foams for cushioning, could and should have received full attention by the expert. The point is made forcibly here, because the recipient country still has a great need for expert assistance in those specific areas of packaging. The duration of this assignment should be repeated if possible, to bring the total time of assistance up to 8 or even 12 months.

2. Factory Visits

Factory visits have been informative and productive. The range of problems raised by each company contains elements which are common to nearly every company visited, but in each case the specific problem was treated as if it was singular and unique to a given company. This was done so as to avoid apparent conflict between converter and his client, or from the point of view of the product manufacturer, such as a confectionery manufacturer, between his company and his converter/s.

In every case, the problems were discussed on the spot and whenever possible the expert worked on the shop floor and at the printing or converting or packaging machine, in order to be sure that the explanations

as to cause and effect were clearly and properly understood by both supervisors and machine operators. Whenever it was considered necessary, management personnel had the technical advice explained to them also, to aid in ensuring that the advice would be implemented.

On each factory visit an attempt was made to explain the exact cause of each problem, and after discussion with the personnel directly involved, suggestions were made of possible solutions to the problem or alleviation of some of the more drastic effects of a problem. Whenever it was applicable, the counterpart was instructed on the spot as to causes of problems, how to view different kinds of problems and how to move towards a solution by making use of the managerial staff of the company being visited. This emphasis on seeking the direct assistance of Management in work upon problems and the need for managerial direction of staff to ensure that advice is properly applied, has been very fruitful.

Although the job description calls for the language for the post being English, most Koreans were found to be extremely poorly equipped to understand technical explanations in the English language. The expert was well-served by the counterpart acting as interpreter, but many of the Korean technologists had difficulty in understanding those technical terms which have to be transliterated in unchanged English language-Words like "sandwich", "colour", "compressive" and "screen", to name only a few.

This difficulty in communication of precise technical answers was not a gross difficulty because the counterpart is a good interpreter but less-effective interpretation could have been a severe bar to communication.

The assimilation threshold of technical information given was high, but was well performed by both KOPC personnel and by the personnel of the companies visited. Two obvious problems for Korean companies quickly became apparent during the first three weeks of factory visits.

a) In many instances, companies are experiencing technical problems which are capable of quick and ready solution by importing the correct grade or quality of material. In many cases it appears that the Government's

overall policy of import substitution sometimes conflicts with Korean interests because such quite specific needs either are not, or cannot, be brought to the notice of the appropriate Minister because an effective lobby for such a purpose does not exist. This kind of problem often resolves itself into the perpetuation of inadquate packaging because the technical aspects of the problem cannot be properly expressed by the personnel of a given company, and so the true corrective action does not take place because the appropriate Minister is not made aware of the problem.

An effective lobby should be brought into being on an industry - wide and all - industries - wide basis, as there are often impingements upon effective Export packaging whichare militating against success in competitive markets overseas. A Korean Packaging Association of Trading Companies might be an effective way of providing a sincere lobby which has the interests of the industry more to the fore than the interests of individual companies.

b) Automatic packaging machinery already in use in Korea works best when using specific grades or combinations of packaging materials as specified by the machinery manufacturer. Pressure of competition at Point of Sale between different but directly- competing Product Manufacturers has led to attempts to change over to packaging materials which do not perform as well mechanically on the machinery, or which cost more than is justifiable in terms of "value added". This conflict resides at lower levels of middle management than are tolerable. Top management should be made aware of the nature of these problems, so that it can correctly formulate the effect of the problem upon the conduct of its business and so direct its attention properly to working towards effective solutions to such problems instead of allowing its non-decision-making lower echelon executives and managers to continue floundering ineffectively simply because they have the responsibility for profitable operation of automatic packaging machinery but do not have the authority to recommend replacement of machinery or packaging materials to meet the changing needs of highly- competitive markets for consumer goods for retail sale.

In some respects, there is a need for closer attention by package designers to the mechanical and physical aspects of production of empty packagings, particularly printing problems. Also, designers may need to be more fully informed of the effects some aspects of their designs have upon the productivity or output of high-speed automatic Form-Fill-and Seal packaging machines.

These two basic problems have been emphasised by the exp rt is simple terms and in tecnhical terms over and over to people involved, in the KDPC and in various companies visited.

The emphasis has been maintained and is recorded here, because the futher effects of such problems are a brake upon the export achievements of Korean companies. These two problems should not be exaggerated unduly, but they must be properly recognised by KDPC and by government as being important and in need of some attention.

Technically the industries visited are coping reasonably well with their problems on a day - to - day basis. There is a high level of knowledge and expertise in most areas of plastics package design but there are gaps in understanding of some of the more technical details, particularly in printing, laminating and most of all in heat sealing theory and practice. These specific areas of difficulty have been given great emphasis by the expert and much time has been spent, together with the counterpart, in trying to fill those gaps in understanding by counselling, by demonstration, and through the medium of two Seminars, one held on 7 May, 1982 on the subject of "World trends in plastics packaging", and the other held on 10 June, 1982 under the title "The General Problems of Plastics Packaging and Their Solutions". Both Seminars were well-attended and well received.

Factory Visits

Visits to Factories are listed hereunder, together with details of technical discussions where the importance of a given subject warrant such detailed treatment.

1. SAMJIN Aluminium Co., Ltd. 82.03.11/12 & 15

33-1, 2-ka, Myung-dong, Chung-ku, Seoul, Tel.: 776-3873
762-5, Anyang-dong, Anyang-city, Kyungi-do Tel.: (1343) 2-1992

Taewon, Park	President
Byongchan, Oh	Managing Director
H.W. Lee	Development Dept.

Technical advice and solutions to the following problems were given on the spot in Anyang City.

a) Elimination of residual solvent in Dry-bonded laminates for confectionery and snack foods.

b) Determination of ink solids content-wet and dry

c) Assessment or measurement of drying capacity on printing and laminating machinery

d) Control of web tension on printing and laminating machinery

e) Methods of testing and techniques for heat sealing of single films and laminates

f) Determination of applied weight and yield of laminating adhesives and printing inks

g) Techniques for prevention of curl in coated and laminated materials

h) Testing methods applicable to the detection of residual solvent in converted packaging materials-glass jar-gas liquid chromatography-mass spectrometry.

i) Assessment of odour transference from wrapper to food contained

j) Reduction of problems related to ink circulation in troughs and lines on gravure printing machines.

k) Status and correct operation of automatic electronic register control of 6 colour rotogravure printing machines.

l) Advice on methods of automatic control of web tracking in laminating and printing machines.

m) Advice on correct temperatures and hardness of rubber back-up rolls used in NIP of dry bond laminating machines.

n) Temperatures at nip of polyethylene extrusion coating machines.

o) Techniques and adhesion promoters for bonding polyethylene to various substrates and midstrates by extrusion coating and/or laminating.

p) Advice on the preparatory processes needed for conventional, variable area/constant depth, and constant area/variable depth methods of rotogravure printing with emphasis on cell design and correct screen angles needed.

q) Advice on basic criteria for the design of distribution packaging for flexible packaging materials in roll, sheet and premade bag or pouch forms.

2. PACIFIC Chemical Industries Co., Ltd. 82.03.16/17

656-9 Sindaebang-dong, Dongjak-ku, Seoul Tel.: 832-7541
234, Gugal-ri, Giheung-myeon, Yonggin-gun, Kyonggi-do Tel.: Suwon 3-3371

Contacts:

Chung Hoon, Seo	Packaging Material Research
Chang Kew, Kim	Director
Sang Rin, Lee	Senior Engineer
In Ho, Lee	R & D Dept. Suwon

Technical advice was given on the spot in Seoul and in Suwon and an in-house Seminar on topical problems was conducted with the R & D staff of the company in Seoul-Problems covered included:

a) Methods for leak prevention at the heat-sealed corners of plastics sachets for concentrated liquid shampoos and lotions and unguents, pastes and creams.

b) Methods for determining the heat-sealing quality and strength of single films and laminates.

c) Methods applicable to adhering microencapsulated fragrances to promotional literature by printing ink means.

d) Seminar discussion of reject levels tolerable in respect of printed rolls of laminates for high-speed snack food Form-Fill-Seal machines (Woodman ex USA).

e) Discussion of solutions to mechanical problems caused by factory layout causing inefficient finished product materials handling practices and buffer storage practices.

f) Demonstration to supervisory staff of the fact that packing-off practices and box base closure methods in use are suffering from the futher effects of e) above.

g) Advice was given on techniques for ensuring silk screen printing ink anchorage to surface of polyester blown bottle by using correct surface treatment prior to printing.

h) Discussion on sources of equipment and information on ultraviolet lacquer curing system for plastics screw caps.

i) Basic design criteria for distribution packages for incoming rolls of flexible plastics packaging materials.

3. NHONG-SHIM Co., Ltd. 82.03.22

370, Shindaebang-dong, Dongjak-ku, Seoul Tel. :832-7601

Contacts:

Bum Sik, Min	R & D Manager
Mr. Shim	Production Manager

Problems discussed and amplified included:

a) Eyespot printing practices and sensitivity for cut off control on packaging machines (Woodman)

b) Factors affecting Heat-sealquality and strength.

c). Materials Handling and buffer storage problems due to restricted factory space and ineffective layout.

d) Waste control techniques and waste levels and tolerances on roll-stock for the Woodman FFS machines

e) Advice on solution to tub-filling machine infeed problems for noodles mix using preformed Expanded Polystyrene Foam(EPS) tubs. A nesting problem stems from tubs jamming at the shoulder due to improper tub design.

f) Advice on alternatives available to solve a problem caused by the particular hand packing method now in use.

g) Basic design criteria for transparent packages for incoming rolls of flexible plastics packaging materials for automatic FFS machines.

4. YOUL CHON Printing Co., Ltd. (A division of NHONG SHIM)

82. 03. 23

666-10, Shihung-dong, Guro-ku, Seoul Tel.: 856 -6931

Contacts:

Jae Sung Shin	Managing Director
Kun Jae Lee	Production Manager

Problems discussed included:

a) Methods for elimination of residual odour from dry-bonded laminates

b) Adhesion promoters and adhesion promotion techniques for polyethylene extrusion coating and laminating

c) Determination of minimum coating weights of adhesive for laminating

d) Specification and determination of solids content of cured dry-bond 2-part polyurethane adhesives

e) Discussion of correct cylinder temperatures and backup roll rubber hardness for the NIP of dry-bond laminating machines.

f) Techniques and materials for pressure-forming Nylon/Polyethylene trays for vacuum-packed luncheon meats

g) Basic design criteria for flexible plastics bags, pouches, sachets and FFS machine wraps

5. LOTTE Confectionery Co., Ltd. 82.03.24/25
20, 4-ka, Yangpyong-dong, Youngdeungpo-ku, Seoul Tel.: 633-0101

Contacts:

Ik Boo, Kwon	Director of R & D
Yong Man, Kim	Packaging Laboratory Manager

Problems discussed included:

a) The curing of dry-bond laminate adhesives

b) The presence and elimination of residual solvents in printed and laminated pouches and wraps for candies and boiled sweets

c) Twist retention qualities in wraps for twist-wrapped sweets- the existing problem is caused by attempts to use non-twisting(non-suppled) grades of cellulose film and other single films such as mono-directional (machine direction) tensilised high-density polyethylene. The correct twisting grade of cellulose film for this purpose is said to be not made in Korea. Advice was given to apply for By-law entry of Suitable twisting grades of cellulose film.

d) Discussion took place on the transferable and extractable components of cellulose film grades currently being used in Korea, which are said to infringe the requirements of a Korean Statutory Authority on food additives and contaminants.
This problem is one involving an unrealistic test which destroys the cellulose film. It would be better to analyse the candy product by gas chromatography or mass spectrometer in order to establish whether any "extractables" which are present in or on the wrapping material are in fact being transferred or extracted onto the surface or into the substance of the product.

e) Advice was given on machinery and techniques for high-speed printing in 5 colour half-tone on conical cups, injection moulded and/or vacuum formed.

f) Technical advice was given on adhesion promoters for polyethylene extrusion-coated and laminated substrates and midstrates which form the components or elements of laminates for high-speed automatic FFS packaging machines.

g) An in-house Seminar was presented on the organisation and operation of packaging standards.

h) The Organization and operation of package development activities.

i) The fundamental rules of determining design criteria for flexible packaging were outlined in detail to enable company personnel to specify their packagings so as to maximise the utilisation of converting machinery and output.

j) Examples were provided of correct approaches to the design criteria which should be applied for various flexible plastics pouch shapes and sizes.

k) Discussion outlined preferential practices to solve existing materials handling and buffer stock storage problems.

l) Advice was given on basic design considerations for distribution package dimensions for products packed in flexible plastics packages.

m) Discussion was entered into on the effects and benefits of unitising and palletising loads for transport, warehousing and distribution.

6. TONG YANG (ORION) Confectionery Co.,Ltd. 82. 03.30/31

30-10 Munbai-dong, Yongsan-ku, Seoul Tel.: 713-5011

Contacts:

Joon Kyung, Chang	Vice President
Dong Jun, Lim	Managing Director
Chung Il, Lee	Product Planning Manager

Problems discussed and amplified included the following:

a) Residual solvent in dry-bonded laminates

b) Quality control and Quality assurance techniques to ensure adequate control of print quality on packagings

c) Heat sealing-techniques, quality levels and machinery settings

d) Twisting grades of cellulose films for twist-wrapped sweets

e) Methods and techniques to eliminate residual solvent odour in dry-bonded laminates using 2-pot polyurethane adhesives

f) Discussion and explanation in technical terms of the comparative properties of Aluminium foil and metallised plastics films for flexible packagings

g) Machinery running conditions for Form-Fill-Seal machines e.g. Voltage stabilisation- eyespot sensitivity-unwinding roll tension-through-machine tension and tracking control and quality of heat-seals.

h) Expansion of those design criteria most commonly involved which cause printing and laminating problems

i) Techniques for cost reduction in packaging materials and laminates

j) Methods for choosing suitable plastics packaging materials - in terms of barrier, heat sealing and machinability properties

k) Extrusion coating and laminating-machinery settings and running conditions-improvements in bond strength

l) Packing room layout and operation

m) Distribution packaging-Design and use

n) Warehousing practices-palletisation and unit loads

7. LOTTE Aluminium Co., Ltd 82.04.1/2, 6/7

516-2, Docksan-dong, Guro-ku, Seoul Tel.: 856-0091

Contacts:

Hyung Kyu, Lee	President
Sun Pyo, Hong	Executive Director
Hyuk, Chee	Printing Dept. Manager

In this company, most of the discussion took place under Seminar conditions in which extensive use was made of the blackboard to illustrate and to explain technical aspects in great depth. The following problems were discussed and advice in relation to solutions was given:

a) Machinery setting and running conditions for dry-bonding of laminates for snack foods and confectionery.

b) Methods needed to maintain and increase print quality in rotogravure and flexographis printing

c) Basic design criteria for flexible plastics packagings

d) Solutions for problems encountered in the printing of hard-tempered aluminium tagger plate

e) Adhesion promoters for dry laminating-running conditions

f) Hotmelt-coated and laminated products-running conditions

g) Choice and selection of packaging materials for specific products

h) Methods for the prevention of curl in dry-bonded and extrusion laminates

i) Bond strength and the maintenance of clarity in laminates

j) Expanded comparison of the physical properties of plastics films

k) Colour-choice, selection, matching inks, and the use of colour in package surface design

l) Heat sealing-methods-equipment-conditions, testing-theory and practice.

m) Problems of tension and telescoping of rewound rolls

n) Materials handling - factory layouts-buffer stocks

o) Packaging of barrier materials for delivery and storage

p) Pouch and bag dimensions-design criteria

q) Warehousing-conditions and practices-unitisation

r) Quality Assurance-Quality control-Waste control

8. HAITAI Confectionery Co.,Ltd. 82. 04.26/27

85,5-ka, Yangpyung-dong, Youngdeungpo-ku, Seoul Tel.:633-0111

Contacts:

Kang Duck , Yun	Managing Director, R & D
Kyu Soon, Rhee	Manager, R & D
Deuk Soo, Kim	Development Manager
K.S. Yang	General Adviser

Problems discussed and expanded were:

a) Twisting grades of cellulose films-alternative sources
b) Residual odour in dry-bonded laminates
c) Stiffness of laminates for FFS machines
d) Heatsealing-conditions-settings -strength
e) Web droop of single films and laminates
f) Surface printing of single films and laminates
g) Preparatory processes for rotogravure printing
h) Hotmelt laminates for Horizontal wrapping machines
i) Laminates for Biscuit-wrapping machines
j) Ink adhesion and residual ink solvents
k) Bag-in-box liquid packaging systems
l) Coated papers for Ice Cream Packaging

9. SAMMIN INDUSTRIAL Chemical Industries, Co.,Ltd.

P.O.Box 444 Central Seoul, and Bucheon Tel.: 752-7859

Contacts:

Mr. Lee	Director
Cheng Sup, Lim	Sales Manager
Mr. Koong	Manager, R & D

Problems discussed were mostly concerned with bond strengths between co-extrudates such as polypropylene/polyethylene, and polyethylene/ethylene vinyl acetate (EVA).

The addresses of a number of companies in USA were provided together with details of suitable grades of plastics resins to enable SAM-MIN Co. to run trials with different materials from those they had been using, which are sourced from Japan and Korea-Although the Japanese and Korean resins are of good intrinsic quality, their machinability on the equipment being used by SAMMIN is less than acceptable, being deficient in bond strength at the interface between the two coextruded plastic resins. Because of this, there is no "wetting" or diffusion taking place, leading to some delamination or separation of the components when the package made from them is in use.

The details of sources of alternative materials appear below:

Address of Companies

USI : U.S. Industrial Chemicals Co.
99 Park Avenue, New York, N.Y. 10016 (212-949-5700)

CHEMPLEX: Chemplex Co.
3100 Golf Rd, Rolling Meadows, IL 60008 (312-437-7800)

REXENE : An affiliate of El Paso Products Co.
P.O.Box 665, Paramus, New Jersey, 07652 (201-262-6500)

GULF : Gulf Oil Chemicals Co. Plastics Division
P.O.Box 1563, Houston, Texas 77001 (713-226-1011)

EASTMAN: Eastman Chemical Products, Inc.
P.O.Box 431 Kingsport, Tennessee 37662 (800-251-0351)

E.I.Du : Pont De Nemours & Co., Inc. Delaware
1007 Market St., Wilmington, DE 19898 (302-774-2421)

RESINS

ITEM	MFI	COMPANY	DEGREE
LDPE	0.4	USI Chemicals PETROTHENE	NA 273
	0.7	" " "	NA 224
	1.0	CHEMPLEX	3401
	1.2	REXENE	PE-220
	1.5	REXENE	PE-256
HDPE	0.85	CHEMPLEX	6109

ITEM	MFI	COMPANY	DEGREE
P P	2.0	GULF	6214
	4.0	"	6414
	50.0	EASTMAN	TENITE 4G 7DP
P P Copolymer	4.0	REXENE	PP 41
	8.0	"	PP 43

10. KOREA HEAVY INDUSTRIES CONSTRUCTION Co.,Ltd. 82.05.10

Contact : Kun Myeong, Lee Manager

This visit served the purpose of familiarisation with the amounts and kinds of flexible plastics packaging which are currently being used by heavy industry companies in their Export packages. The present practices and techniques are fully in line with current world practice.

11. SEO TONG CHEMICAL (STC) Incorporated 82. 05.24

C.P.O.Box 104, Seoul Tel.: 777-0181

Contacts:

B.W. Chung	Plant Managing Director
G. Hansen	Print & Pack Ag. Korea Representative

This visit was one of familiarisation with the scope and range available in Korea for the manufacture of cellulose film and Biaxially-oriented polypropylene film and metallising of plastics films. During the visit an in-house Seminar was conducted to discuss questions raised by members of the company on topical problems such as:

a) Biaxially oriented film-Caliper variations across and along the web- The technique of measuring web droop was demonstrated.

b) Adhesion promotors for metal to plastics film in the vacuum metallising process

c) Barrier properties of metallised plastics films when compared with Aluminium foil

d) Heat sealing of cellulose films and polyolefin films- conditions-settings-strength and quality of seals

12. SHINSUNG Chemical Industries Co.,Ltd. 82. 06.1

C.P.O. Box 7464 Seoul and at Kumchon Tel. 776-6440

Contacts

Huen, Chung	Managing Director
C.K. Na	Sales Manager

This company is engaged in weaving polyethylene and polypropylene for the manufacture of wool bales for the Australian Wool Corporation. They were seeking advice and assistance on sources of suitable twisting grades of paper in order to tender for a pilot-scale order of wool bales made from twisted paper-enshrounded Nylon multifilament woven into a 32/32 cloth and subsequently sewn into the form of a wool bale to specification.

Several sources of paper were indicated and a discussion was held on various other technical aspects, in order to assist the company in the preparation of its tender.

13. HAN IL SIL UP Co.,Ltd. 82. 06. 2

7-1, Wonheung-ri, Wondang-myeon, Goyang-kun, Kyeonggi-do

Tel. 389-8857

Contact : Dai Up, Bang Managing Director

This visit was in the nature of a troubleshooting call. The company was experiencing a problem of odoriferous wax wet-waxed onto a single-purpose all-sulphite paper for wrapping caramels. The odour is that of

burned wax. Discussion covered alternative sources of wax, alternative blends of waxes and copolymers, and machinery setting and running conditions. The problem is capable of solution, but trials with alternative wax blends are the necessary first step towards correcting and eliminating the problem.

Counselling at the Korea Design and Packaging Center

Counselling services were provided in the expert's office at KDPC on request informally whenever the need arose. A total of 17 or 18 different occasions were treated by answering technical questions on a wide range of packaging subjects. The service was supplementary to the counselling services normally offered by KDPC staff.

Seminars and Lectures

Two seminars were conducted, one on 7th May, 1982 titled "World Trends in Flexible Packaging" and one on 10th June, 1982 titled "The General Problems of Plastics Packaging and their Solutions".

Both these seminars were delivered by the Expert and Counterpart working together as a team. The delivery was made by the Expert in English, followed by the counterpart making the identical statement in Korean(HAN GUL) language.

The notes for the Seminar of 7th May were printed in both English and Korean language, while those for the Seminar of 10th June were printed only in Han-gul, due to pressure of time on the Counterpart in the difficult task of translating much detailed technical content, some of it sophisticated and abstruse. The counterpart performed extremely well in both roles, as scribe and interpreter in preparing the Korean version, and in delivering the spoken version in Korean language on the occasion. The printed copies of those two Seminars are included with this report as appendices.

A copy of the seminar of 10 June has been added to this report in English language as appendix No. 3 for the sake of completeness.

These Seminars served a number of valuable purposes including the dissemination of needed technical information to a wide-ranging audience much larger than the number of technical people who had been contacted by means of factory visits. The Seminars were illustrated with 35mm colour slides specially prepared by the Expert for Korean packaging problems using actual Korean packages to ensure the utmost topicality.

Throughout the period of the assignment emphasis has been placed on identifying the correct problem and then offering advice or suggesting solutions. The counterpart has adopted this approach and uses it extremely well in "live" situations.

UNRESOLVED PROBLEMS

No specific problems are left unresolved. Each problem raised has been dealt with immediately by the Expert and Counter-part working together. There are, however, two aspects of problems which need the support and assistance of the government for their resolution. These problems are concerned with the difficulties faced by converters in Korea when seeking to import specialised packaging materials which are not made in Korea and will not be made in the foreseeable future, either on economic grounds or on the basis of there being no opportunity to manufacture or convert under licens

The first of these problems concerns the importation of special materials like PVDC coated cellulose films and PVDC coated plastics films which are needed for the packaging of staple and convenience foods. As mensioned earlier under "General Observations", some kind of lobby mechanism should be set up so that industry can reach the ear of government on an industry-need basis. That is not happening at present because there is apparently no "Korean Packaging Association" to coin a name. Such an industry association, which would be a commercial or trade association, cannot operate successfully under the aegis of the KPDC, because its needs must be "selfishly" commercial. The KDPC premises, however, would be an ideal venue for its meetings.

The second problem is more difficult. The present allowances for amortisation of plant and equipment do not seem to encourage product manufacturers (who are engaged in mass-volume production of only pre-packaged convenience and leisure foods and drinks) to install and operate on a planned obsolescence basis. Yet that is what Korea needs to do in order to increase its export markets for such high-volume, low-order goods.

The retention of packaging equipment beyond its useful working life is happening in Korea and that is one aspect of this problem. The other major aspect may seem to be abstruse, but it is not. It is very real.

Some of the automatic and semi-automatic packaging machinery installed in Korean factories was designed to use specific kinds and qualities of plastics films and laminates which were acceptably priced at the time of installation but which now cost more per unit of area used than more-recently developed single films, duplex structures, and laminates. The feature of constant and rapid change in the area of packaging materials supply is a maior problem for all manufacturers all over the world. It is particularly relevant to Korea at the present time, because an increase in export income is dependent upon viability in foreign (export) markets. Some of the exported and exportable commodities being manufactured in Korea are at a cost disadvantage for the reasons outlined above. Corrective action here also probably needs the presence of an industry association to form an effective lobby.

These suggestions are made here for purely practical reasons. Korean industry is at a disadvantage in competing with similar products packed in "more modern" plastics materials which are available at somewhat lower cost in their countries of origin. Until or unless some amelioration of these twin cost and performance penalties can be provided, Korean industry will continue to languish in regard to export markets in Asia, for convenience foods and drinks.

IV. RECOMMENDATIONS

1. Set up a "Korean Packaging Association" as a trade association as an urgent priority. Membership should be on company, professional (individual) and ordinary member (individual) bases, with fees determined by the Steering Committee which should be set up without delay. The funding for corporate operation may be based on annual turnover of corporate members.

The urgent need for such an organization has already been referred to earlier in this report. Such an organization would quickly provide incentives and ways and means to enhance the international competitiveness of local (Korean) packaged goods. The need to make fast changes in packages in response to fast changes in the requirements of the market place calls for the special skills of the managements of companies already involved in the manufacture, distribution and sale of prepackaged goods, particularly foods and drinks.

2. Seek government assistance for KDPC to become the architect and possibly the administrator of a technical school or college of printing technology. There is an urgent need for such a school. The expert's experience in visiting converters in Korea has high lighted this urgent need, as shown in the content of this final report. Printing preparatory processes, printing techniques, printing machinery, ink technology and quality control should be mandatory subjects for all students attending such a school

3. KDPC should attempt to invite members of KDPC to assist KDPC further in attempts to develop an outward-looking strategy for modernising packaging lines and adopting the most modern developments in flexible and rigid plastics packaging, even by importing certain materials if necessary. Import substitution is a necessary plank of government policy at present. The suggestion that certain special packaging materials should be imported is not a suggestion to abandon import substitution. It is a recognition of the fact that specific technical products are needed and are not available due to

difficulties of supply which are exacerbated by some aspects of the government's import licencing policy.

4. The Korean packaging industry has a noticeable tendency to shy away from factory trials of new or "more expensive" packaging materials because the decision makers (those who can authorise the expenditure of more than $500 without prior referral to higher authority within a company) are not involving themseves properly at the grass roots level within their own company. This results in much wasted endeavour in package development. It is a contributant to retention of packaging lines beyond their viable economic life span and it creates and has created an inward-looking posture on the part of R & D managers, at least some of those met by the Expert during factory visits. This is not an impolite or destructive criticism. It is a statement of simple fact. It is recommended that KDPC strengthen its advice to its members, to budget more research funds for factory trials of new packaging materials, techniques and machinery.

5. KDPC should consider conducting courses in Value Analysis. The expert has so far seen no evidence anywhere in Korea that VA is being used by any company in any field of endeavour. If necessary UNIDO should consider providing an expert in VA/VE for a minimum of 6 months, to teach this very important technique to all staff of KDPC. VA is extremely important for effective package development.

6. KDPC should consider conducting courses in networking, PERT and CPA. The expert has so far seen no evidence anywhere in Korea that CPM/CPA is being used by any company in any field of endeavour. If necessary UNIDO should consider providing an expert in CPM/CPA for a minimum of 6 months, to teach this very important technique, first to selected staff of KDPC and then to as wide a range of industrial companies as possible. CPM is very important for effecitve package development.

7. KDPC should emphasise to its members the fact that when a packaging machinery manufacturer recommends a particular material or laminate for use on the machinery, that material should be conscientiously provided and used

strictly in accordance with the machinery manufacturer's recommendation or specification. The expert has observed numerous attempts by companies to substitute less -expensive, but less-effective materials, because the specified or recommended materials have risen in price, or can not be imported because local suppliers claim they can supply.

8. KDPC should seek extra funds to increase by about 500%, the number of English-language serial publications (magazines) on packaging and printing and converting. This is an urgent need. Satisfaction of that need would serve two purposes.

a) Provide a wider range of exposure to current packaging technology for staff of KDPC and members of KDPC and the general public.

b) Enhance a more rapid understanding of the mastery of English language, which is the universal language of trade and commerce. This suggestion is made because the expert has observed a tendency for Korean companies to want to read and study packaging technology in HAN-GUL language rather than in English language. While understandable, the tendency is liable to perpetuate gaps in technial understanding which have already been identified by the expert as existing only because some of the people involved in package development, package converting, and package design, seem to desire to take refuge in Han Gul language.

The expert is sympathetic to this natural desire to use and to promote the national language. But the expert makes this recommendation because he has seen penalties occurring because of this tendency to avoid full involvement in the use of English language when dealing with western technology. The recommendation is strengthened by the fact that the counterpart is more competent in his mastery of Enlish language than most of the executives and technologists met during factory visits and discussions during the period of this assignment.

That better understanding of English language has enabled the counterpart to absorb the technical details inherent in problems raised by companies, more quickly than it could be absorbed by the company personnel.

9. The Korean snack foods, confectionery, ice cream and soft drinks industries should carefully evaluate their current practice of demanding sandwich printing of dry-bonded laminates for products which sell at a price below ₩250. The use of the ultimate in package quality is not always justifiable for high-volume, low order products. The use of such sophicated packaging should be monitored carefully to ensure that hidden costs are not reducing profitability through the use of unnecessrily expensive flexible plastics packaging materials, since most of the materials referred to are derived from petroleum products, a non-renewable resource.

10. KDPC should expand its activities in the field of surface design of packaging (graphics) as it directly affects and is affected by, the choice of printing method, therefore the preparatory processes applicable to that method. This could be done by concentrating one or two of the staff members' study pattern into that area of specialisation. The special evaluation of seven Korean convenience food flexible packages which is contained in Appendix B is good evidence of the need for this. The packages evaluated were all less than 65% effective for the job they had to do. They failed mostly in the surface design factors.

11. Consideration should be given by both KDPC and UNIDO to providing another assignment for expert advice to those other sectors of plastics packaging in Korea which could not be serviced by the Expert because this assignment was too short to allow full coverage of all the major industrial sectors which are dependent upon plastics packaging for their export achievement.

As stated in the body of this report and in the interim report, no service could be given to:

a) Plastics foam manufacturers and converters
b) Cushioning design using plastics foams for fragile products
c) Automotive spare parts packagings
d) Electronics, Components packagings
e) Telecommunications packagings
f) Hospital and Medical disposables packagings
g) Institutional packaging using plastics materials
h) Flexible plastics packagings for military supplies and rations.

Such a program of activities would need at least six months, more likely 12 months attention by an expert.

Other recommendations will be found to be embedded within the various appendices to this report. They have not been listed separately, to ensure that the main recommendations can be clearly seen as being most urgent and most likely to be fruitful in producing worthwhile and lasting results.

V. EPILOGUE

This expert takes this opportunity to give thanks and congratulations to both the UNDP office and staff in Seoul, and to the Management and Staff of the KDPC for the effective and co-operative manner in which the facilities have been made available. Working conditions and personal relationships have been extremely good from start to finish of the Assignment.

Appendix A

WORLD TRENDS IN FLEXIBLE PACKAGING

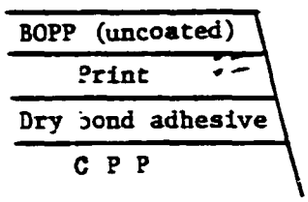
1. The rise of metallised films
2. Increased consumption of laminates
3. The current status of retortable pouches
4. The inroads made by OPP against Cellulose films
5. Polyester and Nylon- Why are they so important ?
6. Cellulose film
7. EVA and EVA Copolymers - Attributes
8. Printing - The Art Preservative of all Arts

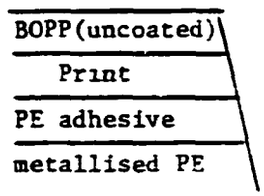
   Buried or Sandwich Print versus Surface Print
9. Print Lamination
10. Duplex and triplex combinations-unbonded-the airlessflow wine bag-in-box

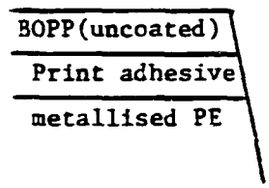
1. The rise of metallised films

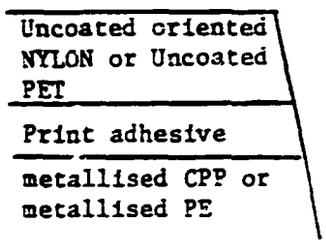
During the last ten years vacuum metallised plastics films have shown more growth than any other sector of flexible packaging or plastics packaging. This is because the cost of added benefit in using metallised films is less than the cost of achieving the same added benefit by using other means or materials.

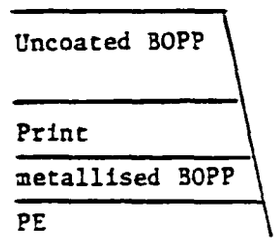
Consider these alternatives as an example :

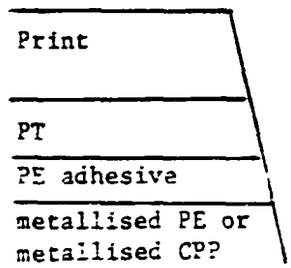












No costs are given here, because cost is dependent on frequency, volume, etc, but each of these six structures would be suitable for sandwich printed packs for snack foods and similar convenience foods.

One of them will be cheapest, one dearest, which is which ?

In quite specific terms, a laminate of oriented Nylon and metallised LDPE gives better performance in gas barrier, moisture vapor barrier, flex crack resistance and cost per unit of area than any other structure which is available at the same cost per unit area.

Metallised Cellophane/PVDC film is more costly today (in most countries) than is metallised OPP coated with PVDC.

One should make the decision about which metallised laminate is most suitable for a given product by taking note of the product requirements first then the performance capabilities of the laminate (light, moisture, gas barrier, flex crack resistance, pinole resistance, printability, heat seal strength, machinability and price per unit area).

The number of options now available by using metallised films in various combinations is enormous and it is continuing to grow.

Converters and product manufacturers who are actively seeking greater market share will find many opportunities by using metallised films.

2. Increased consumption of laminates

Very often a laminate must be used because single films cannot provide all of the desirable properties which are required to protect and present products which are sensitive to light, moisture, or to degradation from other agents such as oxygen.

Most laminates perform two functions. The first is the ability to provide an hermetic seal, and the other is to provide barrier protection against the causes of spoilage, damage and loss. Decoration, although it becomes most important at the Point of Purchase is usually the least important consideration in cost per unit area.

Sealants

Sealants include low density polyethylene, Ionomer,, and EVA copolymers. There are differences in seal strength, resistance to moisture, grease and oils, organic solvents, and in tear propagation, but each of the three produces excellent heat seals.

Polyethylene when used as a sealant, exhibits high tear propagation resistance, good tensile strength, good extensibility, is unaffected by water and does not support mould growth. It is undoubtedly the most important heat sealable medium used in laminates.

Ionomers have greater toughness than polyethylene and they have a better grease and oil resistance combined with good seal strength.

Although Ionomer is more expensive than LDPE, the ability to function as well in thinner gauges at about the same cost per unit area often forms a justification for its use.

The EVA copolymers have the advantage of low sealing temperature, and like Ionomer, will achieve a good heat seal even when the seal area is lightly contaminated by product just prior to sealing.

Cellophane films depend for sealing on applied coatings which are usually very thin. The anchorage of the coating at the temperatures used in heat sealing under pressure makes the achievement of true weld seals almost impossible at the coating/regenerated Cellophane interface, and so the seals are not generally liquid-tight. If they are not liquid-tight. they will not be gas-tight. The sealant most used on Cellophane films today is PVDC.

When, however, PVDC is coated onto polyolefins such as OPP,CPP and PE, the combination becomes very effective indeed.

Barrier Properties

Of all the flexible materials used in laminates, Al-foil is incontestably supreme as a moisture vapour, gas, and light barrier.

The two disadvantages most often referred to aluminium foil, that is: pinholes and the presense of heat flash; are relatively unimportant.

Pinhole counts and their effect upon the barrier properties of Al-foil were fully investigated many years ago and the myth of poor barrier performance was exploded by the simple technique of using Al-foil in direct combination with an extrusion coating of polyethylene. This occluded the pinholes in a very satisfactory manner.

The matter of heat flash is overcome by the greatly improved accuracy of thermostatic controls on the sealing bars of packaging machines.

So far as Al-foil is concerned, the simple presence of Al-foil in a laminate will automatically ensure a moisture vapour transmission rate of less than 1 gram/m^2/24 hour at 37°C - 90% RH.

That is not the case with laminates made by combining only plastics films. The onset of metallised plastics films has improved barrier performance slightly, but the metallic coating does not provide a complete barrier to moisture light and gases as does Al-foil.

A simple way to place this matter into correct perspective is this; A laminate of Paper/PE/Al-foil/PE will have a WVTR of less than 1 gram/m^2/24 hour. A laminate such as metallised oriented Nylon/PE/OPP/PE will have a WVTR greater than 2 gram/m^2/24 hour. The plastics laminate allows more than 100% more moisture vapour, or gas, to pass than does the Al-foil laminate.

The Al-foil laminate is therefore at least twice as good a barrier. There is a great need to keep a sense of proportion in relation to the level of barrier protection which is needed by a given product. Many products have nó need for protection levels as low as WVTR of less than 10 gram/m^2/24 hour. Some can tolerate levels as high as 30 gram/m^2/24 hour.

So why should product manufacturers use always and only the most expensive or best barriers known to technology ?

If a product is turned over within one month it may need barrier protection at a level of, say, 10gram/m^2/24 hour. If it turns over in 1 week, it only needs a barrier level of 40 gram/m^2/24hour.

When this pragmatic approach is applied, many cases of overpackaging will disappear.

3. The current status of retortable pouches

I shall not discuss the physical structure of retortable pouches in ultimate detail, since there is a great deal of information already available in the literature. What I would like to discuss with you, are points which I consider are most meaningful for this intriguing subject wherein the flexible packaging industry has set its sights on a target of capturing a significant portion of the market now possessed almost exclusively by metal cans.

Retorting means cooking processed vegetable or meat products in hermetically-sealed packages at elevated temperatures and often (in steam retorting), at elevated pressures.

Several salient points should be noted.

a) There is a minimum temperature below which certain bacteria will not be killed by heat or steam. The packaging material and the seals must be able to withstand that temperature with an adquate safety margin(say, 50%) at the given pressure.

b) Because metal cans are cylindrical and seldom used for retorted products in sizes less than 50mm diameter, there is a minimum thickness of product from the wall of the can to the centre of the product, of 25mm. The rate of heat flow to reach the centre of the canned product, and the time needed to reach the threshold temperature at which sterilisation is ensured are important economic factors. They are limited to a large extent by the geometry of the packages.

Retortable pouches, being usually less than 25mm thick when filled and sealed,contain less product but reheat or sterilize the product much faster because heat penetration into the food is faster and more effective.

To give an example, a can measuring 50mm diameter x 100mm high has a volume of $196cm^3$ and a surface area of $196cm^2$. The surface area to volume is therefore as 1 is to 1.

A retortable pouch, holding the same volume of product, being only 10mm thick at the point of maximum bulge, would have an internal volume of, say $200cm^3$ and a surface area of $2 \times 450cm^2 = 900cm^2$. The surface area/ volume ratio would be 4.5 : 1.

We could therefore expect that reheating or retorting could be achieved in about 50% of the time needed for the can.

c) That would appear to be a significant plus for the pouch over the can, and it is. But there is a penalty. The pouch seems to occupy much more space than the can, and this is a marketing benefit as well as a penalty. It is a penalty because the housewife may see it for what it is -over-packaging.

But it is only overpackaging in one particular sense-appearance. It is a marketing benefit because the display face area is much greater than that offered by the can. If the pouch can be made at a cost which is competitive with the cost of can plus label, then the pouch is viable. If the pouch can only compete on a cost basis with a can printed by lithography on the tinplate, then the pouch is not economically viable because most canned foods are packed in "open top" cans and use a paper label.

d) The strength of the heat seals has been one of the more controversial aspects of retortable pouches and it is in my opinion probably the most important consideration of all. There is a need to ensure a minimum heat seal strength of about 1.5 kg/25mm width. I have already seen, here in Korea, retotable pouches with seal strength approaching 5kg/25mm width. That is not needed, and it should be discouraged. It is a form of over-packaging.

e) The use of Al-foil in retortable pouches is related to three requirements.

1) The provision of adequate barrier properties to ensure the required shelf-life

2) As an aid to heat transfer during retorting or reheating

3) For appearance at Point of purchase and Point of consumption.

None of those requirements is essential to the production of a viable pouch. One may make a retortable pouch entirely without Al-foil and still achieve: long shelf-life, fast reheating and high Eye appeal at Point of purchase.

f) The distinction between retorting and reheating should be clearly drawn, as many companies are attemptingto introduce highly-sophisticated retortable pouches for use in packaging processed convenience or institutional food products which will never be retorted, only reheated, either by boiling in water, reheating by wet steam externally or, where no Al-foil is present, by the use of a microwave or even an ordinary domestic oven. The risk of overpackaging in this way has already caused loss of public confidence in

retortable pouches in the past. Those who wish to promote retortable or boil-in-bag pouches should remember that the consumer is very perceptive and sensitive to anything which may appear to be designed to deceive.

g) I believe that the retortable pouch has already been fully developed to a satisfactory level technically, but the marketing problems, and the reheating problems are still not fully-understood.
Apparent size of the pouch, apparent volume of content, the general appearance of strength and fact that the food is intended to be reheated in the pouch, not reheated in pan or pot, have not yet been properly presented to the public. Until they have been so presented, and the public fully-convinced, market acceptance will be a long, slow process.

h) Breaking into the established markets now monopolized by canning companies is made difficult by the simple problem of filling speed. Many can lines run rotary filling machines at speed up to 600 cans/minute or more. There have not yet been any significantly-successful pouch filling machines developed which can maintain that output rate over a 2-shift working day.

i) The last problem to which I shall refer is concerned with the formulation or ingredients of the food intended to be presented. These should be of a nature that will not produce moulds or allow bacteria to develop if the package reaches a temperature conducive to increase in bacteria count, prior to its being reheated. Statutory Authorities and Food Approval Controls keep a sharp eye on this, but it should not be forgotten that many products packed in flexible pouches are not retorted or reheated until many weeks after sealing. It may become necessary for companies to actually retort in their factories as a safety measure, before distribution.

4. The inroads made by OPP against Cellophane films

During the last ten years the cost of Cellophane films coated with PVDC has risen faster than the cost of oriented polypropylene film coated with PVDC. At the same time, the volume of sales of coated Cellophane films

has fallen by about 30% while the volume of sales of coated OPP has risen by about 20%.

The trend is expected to continue, and by 1984 PVDC coated OPP will have passed PVDC coated Cellophane film in total sales volume. Cellophane film technology has reached its peak, and there are some waste-water disposal problems which do not affect the manufacturers of polypropylene films. The world sales position for polypropylene is therefore that of an expanding market whereas that for cellulose films is a contracting one.

Substitution of OPP for cellulose film is now fairly common, particularly when OPP is required to have PVDC or polyethylene as a barrier or heat sealing coat. This substitution is not likely to rise much above 60% being occupied by OPP, because the machinability of OPP is different from that of cellulose films.

If the packaging industry converts more of its equipment to run OPP or replaces equipment for cellulose film with that which is suitable for OPP, the subsititution level could reach 70% but is not likely to go beyond.

That is because there are some applications for which cellulose film is better than OPP.

Where PVDC coated OPP is needed for oxygen barrier purposes, cellulose film coated with PVDC can compete in performance but not in price. Where the coating is only required for the provision of strong heat seals without the need to use the hot wire sealing method, OPP has properties which also allow the material to release from sealing jaws cleanly. Coextruded OPP/PE is cheaper than PE coated Cellophane films and both are cheaper than PVDC coated OPP.

There are many products which do not need high oxygen barrier protection and in those cases OPP/PE is quite adequate. Potato crisps is one such product class. Shelf-life testing on a comparative basis is the only reliable way to determine the actual level of oxygen uptake which can occur before the product becomes unsaleable. For this reason, it would seem logical to expect that there may be many opportunities to achieve a more rational use of OPP in combination with suitable coating for a multitude of existing products. The criterion for decision must always be overall

packaging cost, including packaging machine throughput rates as well as energy costs and not just a comparision of the cost of the packaging materials alone, taken in isolation.

5. Polyester and Nylon films - Why are they so important ?

Recent change in cost relativities of plastics films has accentuated the fact that overall packaging cost, while partly dependent upon basic film or laminates cost, is composed also of elements of machinery cost, energy cost, insurance, the cost of borrowing money, and amortisation costs.

Recognition of these interdependencies has sharpened management's appreciation of one simple fact, that in the final analysis, overall packaging cost can be demonstrated by the area of packaging material which contains a full year's output of production. That area of packaging material contains all hidden costs as well as the obvious and "measurable" costs.

For example, if a company uses 0.1 m^2 of flexible film or laminate for each retail package and produces 100 million packages in a year, it will also produce 10,000,000m^2 of material in the form of finished, sealed packages. To do that, it may have to buy 11,130,000 m^2 of "empty" packaging material.

That means that between parent rolls to finished package 11.5% of all material has been consumed by unavoidable waste or through avoidable waste. Such items as edge trim and lead-in, lead-out material at the start and finish of printing and slitting are examples of "unavoidable" waste. In many cases, however, the width of trim may be greater than what is truly a minimum and in many other cases residual problems such as curl, or reject print, or reject rolls contribute to the overall loss.

If you think that 11.5% seems to be too high a figure, consider this. A parent roll 1100mm wide as used on a typical gravure printing press 1200mm wide may need to have 7mm trimmed off each side of the roll at the slitter. Is your parent roll trim never more than 7mm wide?

7mm x 2 = 14mm = 1.27% of 1100mm
8mm x 2 = 16mm = 1.45% of 1100mm
9mm x 2 = 18mm = 1.64% of 1100mm
10mm x 2 = 20mm = 1.82% of 1100mm

Let us construct a table of such losses based on a machine width of 1200mm and parent roll width from 800mm to 1100mm.

Table 1

Printing and Slitting losses
% loss of material caused by (2 sides) "unavoidable" trim of parent rolls on machines.

Total width of trim (mm)	Parent roll width 700mm	Parent roll width 800mm	Parent roll width 900mm	Parent roll width 1000mm	Parent roll width 1100mm
6	0.86	0.75	0.67	0.65	0.55
8	1.14	1.00	0.88	0.80	0.73
10	1.43	1.25	1.11	1.00	0.91
12	1.71	1.50	1.33	1.20	1.09
14	2.00	1.75	1.56	1.40	1.27
16	2.29	2.00	2.78	1.60	1.45
18	2.57	2.25	2.00	1.80	1.64
20	2.86	2.50	2.22	2.00	1.82

Les us now put a money value on the wasted film. Do you charge the wasted film at the cost of film or the cost of printed film?

It should be charged as printed-and-slit film, because it has actually been printed and slit. If the film costs for polyester are w2130000/tonne or for Nylon, w2272000/tonne, then the yields will be for 12μ thickness:

for polyester, 98717m^2/tonne = 21.58w/m^2
for Nylon, 120370m^2/tonne = 18.88w/m^2

Do you buy Polyester and Nylon by the Kg and use it and sell it on an area basis? Why? Why not buy it on an area basis?

Look now at our cost of waste, using the same layout as for Table 1, but logging the cost in Won, of each of those percentages of waste, and assuming that the cost of printed film is twice the cost of unprinted film. The figures shown are hypothetical but indicative of reality.

Table 2 PRINTING & SLITTING - TRIM WASTE COSTS

Based on per tonne of printed film
for polyester : W 43.15366/m
for Nylon : W 37.75028/m

Kinds	Total width of trim (mm)	Roll width 700mm trim cost(W)	Roll width 800mm trim cost(W)	Roll width 900mm trim cost(W)	Roll width 1000mm trim cost(W)	Roll width 1100mm trim cost(W)
Polyester	6	36,636	31,950	28,542	27,690	23,430
Nylon		39,078	34,080	30,445	29,536	24,992
Polyester	8	48,564	42,600	37,488	34,080	31,098
Nylon		51,802	45,440	39,987	36,352	33,171
Polyester	10	60,918	53,250	47,286	42,600	38,766
Nylon		64,979	56,800	50,438	45,440	46,350
Polyester	12	72,846	63,900	56,658	51,120	46,434
Nylon		77,702	68,160	60,435	54,528	49,530
Polyester	14	85,200	74,550	66,456	59,640	54,102
Nylon		90,880	79,520	70,886	63,616	57,709
Polyester	16	97,554	85,200	75,828	68,160	61,770
Nylon		104,058	90,380	80,883	72,704	65,888
Polyester	18	109,482	95,850	85,200	76,680	69,364
Nylon		116,780	102,240	90,880	81,792	74,522
Polyester	20	121,836	106,500	94,572	85,200	77,532
Nylon		129,958	113,600	100,876	90,800	82,701

This short exposition of the costs of trim waste has been introduced here to emphasise the fact that even inexpensive film or laminates can produce high losses if the converter or product manufacturer does not carefully control every factor which can produce waste. The size and shape of the finished package, the number of colours and the amount of ink coverage, the total grammage of a laminate, the width of heat seals, and the amount of free space within a finished, sealed package all contribute to loss and waste.

When we consider so-called "expensive" films like Polyester and Nylon, it becomes very important to design the package with all of the points mentioned above very clearly in mind.

Polyester films have extremely good tear resistance, tensile strength, clarity, moderate oxygen permeability, excellent heat resistance and good ageing properties.

Polyester is commonly used in 12μ thickness giving a high yield. The rate of oxygen transmission by permeation can be lessened by coating or co-extrusion with PVDC.

A special heat-shrinkable grade is available by import, but this would only be needed for special purposes.

A common dry laminate structure may be

Polyester	Polyester
print	print
dry bond adhesive	PE
aluminium foil	metallised PE
PE	

Similar structures are widely used for packaging pharmaceuticals, cosmetics, snack foods, powdered foods, cheese and luncheon meats and dehydrated soups.

Nylon films are used in a number of different grades but at present Nylon 6 is the most commonly used grade.

Nylon has a resonably low permeability to oxygen, good high temperature resistance, high resistance to oils and fats, and also is resistant to abrasion.

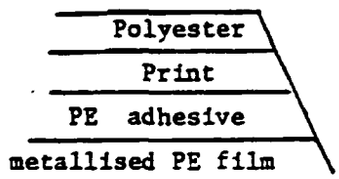
Nylon can be used for thermoforming into shallow or deep trays for vaccum packed meats, etc, in gauges between 100 μ and 150 μ Nylon is water-sensitive, and may become excessively stiff if filled with a product containing water.

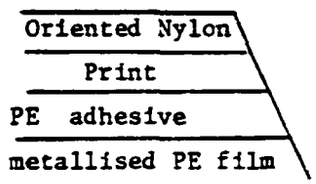
When coated with PVDC its oxygen barrier properties are superb.
Polyester, Nylon and OPP are three films with excellent stiffness for passage through automatic form, fill, and seal machines.
Each needs the support of other materials such as Aluminium foil, polyethylene or EVA to fulfill the role of complete barrier and heat sealability.

Both polyester and Nylon may be suitable for ink lamination using special "adhesive" inks as the last colour to be printed in sandwich printing.

For good results the ink coverage should be not less than 90 % but the adhesive inks normally used for print lamination work best with cellulose film and polypropylene.

Consider these two exciting possibilities





The new Nylon co-polymer films offer great opportunities for alert product manufacturers.

A co-extruded Nylon/PE film without curling can be obtained if one of the recently developed Nylon copolymers is used.

Both of those structures would be very competitive in cost with other structures in common use, when all properties are considered.
The criteria for selection of such laminates should be :

a) All-round performance in appearance, barrier properties, machinability, reliability

b) Availability

c) Cost

In the field of blister packaging, Polyester in the form of co-polyesters (polycyclohexylene dimethylene tetraphthalate) PCTA and (polyethylene tetraphthalate Glycol modified) PETG, are both eminently suitable for blister packaging for pharmaceuticals and medical packaging.

These polyester materials are superior to the unplasticised vinyls in having higher yield, and they do not degenerate or discolour when sterilised by Gamma rays at normal dosages of 2.5 to 5.0 Mrad.

There are of two these coming into popular use in U.S.A.
One called "CRILON" CR9 is based on caprolactam and the other, called CR8, is based on Laurylactam.
They both have properties between those of Nylon 6 and Nylon 12. Both have excellent deep drawing properties similar to those exhibited by Nylon 12, which is used in making blown Nylon films. When laurylactam is incorporated in these new Nylon copolymers they are extremely effective materials for blowing Nylon film because of the reduced viscosity of the melt. Both Nylon and Polyester are also being used in many other areas of flexible packaging where their physical properties and very high yield make them competitive on an overall basis with some of the older materials such as cellulose films and vinyls and cast polypropylene.

Product manufacturers should incorporate at least one laminate or co-extrusion of both Polyester and of Nylon into their product range. That step will enable a company to gain direct experience in the use and the marketing of products packed in these remarkable modern materials.

6. Cellulose Films

There are two basic kinds of Cellulose film - those which are not coated at all, and those which are coated.

Uncoated Films

PT(Plain, Transparent) film is used for hand wraps and in sheets. It is sometimes used in laminates under the mistaken impression that its clarity, being better than that of the coated cellulose films, is an

advantage at point of sale. The differences in clarity are only apparent when direct comparison is made one against the other.

At point of sale, all the packages of one product or variety will be of MSAT or of PT, and there will be no discernable difference in appearance. Where two competing packages are displayed side-by-side at point of purchase, differences in see-through clarity or contact clarity between PT and MSAT cellulose films, when printed in different designs, using different colour schemes, cannot be detected with certainty by visual assessment.

The matter is highly sujective and should not be given the force of certainty, unless the see-through clarity and the contact clarity are measured using sophisticated instrumental methods.

Coated Films

The coated films are coated mainly for two purposes.
The first one is to offer barrier properties against moisture vapour, the permanent gases (O_2,N_2 and CO_2), and grease and oil resistance.

The second purpose of coating is to provide a medium on one or both sides of the sheet or web of regenerated cellulose film, which will be heat sealable under conditions which operate on low-to-medium speed packaging machines (speeds not exceeding 300 packages per minute).

Since the advent of the PVDC coated and more recently, PE coated cellulose films, the moisture and gas barrier properties have been greatly enhanced by PVDC for a very wide range of hygroscopic and oxygen-sensitive products.

But in recent times, coated cellulose films have been overtaken by Biaxially - Oriented Polypropylene films (BOPP), coated on either one or both sides with PVDC or with low density polyethylene.

In the case of BOPP, the PVDC or PE is needed to act as heat-sealant, because BOPP can not be sealed readily at the needed temperatures by conventional sealing machines.

This is due to the fact that at the needed temperature of fusion to produce a true weld seal, the polypropylene film has already begun to shrink away from the source of heat, and some embrittlement close to and parallel with the seal line leads to unreliable seals. In general terms, OPP is considered to be unsuitable for heatsealing.

Cast polypropylene (CPP) is not much better. Although it is possible to heat seal CPP, this can only be done over a temperature range of about 8^{o} - $10^{o}C$.

Depending upon the source of manufacture and manufacturing methods in-plant, it is possible to obtain heat seals in this narrow 8 - $10^{o}C$ range within the limits of approximately $160^{o}C$ to $210^{o}C$, but the strength of seal leaves much to be desired. When CPP is combined by laminating with coated cellulose films, the critical area during heat sealing is the interface between the adhesive and cellulose film.

Because regenerated cellulose does not melt at conventional heat sealing temperatures, but the coated material does, the previously existing bond between regenerated cellulose and the coating melts. Since most heatsealing machinery using cellulose films or laminates containing cellulose film are of the "constant heat" type, this further disadvantage is sharply pointed up by the much better seal strength achieved by the polyolefins at lower temperatures (about $130^{o}C$) on the same machines.

When this variety of difficulties which now confront established cellulose film markets is properly appreciated, the conclusion must be accepted that the cellulose film markets are likely to decline to about 60% of their previous peak in 1975 - 1980.

7. EVA and EVA copolymers-attributes

Ethylene-vinyl-acetate and copolymers made with it are a fairly recent addition to the ranks of filmic materials used in laminates.

They have an interesting series of physical properties and are readily available. They are used mainly as free films in duplex and triplex unbonded laminates, or as bonded films in adhesive laminates. EVA copolymers

may also be extrusion coated or laminated as a subsititute for low or medium density polyethylene.

The most important physical property which EVA offers to the user and converter of laminates is the very strong heat seals which can be achieved at low temperatures. Sealing can be achieved within the range from 125°C to 200°C. As with all single films, EVA shows very strong performance capability in some physical properties and less-effective performance in others.

Here is a simple outline of EVA when compared with low density polyethylene (LDPE).

EVA has a density similar to HDPE. It is only slightly worse in yield (m^2/Kg) than LDPE, while it has a matching tensile strength. Elongation at time-of-break is better than LDPE at the low end of the range, and about equal at the high end. (LDPE % elongation = 100 - 750
EVA % elongation = 500 - 800)

Bursting strengths are identical. EVA is deficient in tearing strength compared with LDPE. Both films have very high folding endurance. EVA will transmit about twice as much moisture vapour as LDPE (ASTM E 96-E). Its gas transmission rate is also approximately 100% greater than of LDPE for the permanent gases (O_2, N_2 and CO_2).

EVA is about equally as bad as LDPE in resistance to oils and greases, but it is equally as excellent as LDPE in its resistance to strong alkalis. EVA has relatively poor resistance to heat but excellent resistance to cold.

Both EVA and LDPE are available in grades approved by the U.S. Food and Drug Administration (FDA).

Overall, EVA tends to produce a slightly stronger heat seal and this is easy to achieve on high speed packaging machines.
I consider that EVA will make as big an impact in the form of the sealant in dry bonded laminates and print laminates, against CPP, as OPP has made against cellulose films.

At present, EVA film is used extensively as the sealant in unbonded (free film) duplex and triplex combinations for liquid products.

7. Printing - The Art Preservative of all Arts
Buried or Sandwich Printing versus Surface Printing

This exposition on rotary printing for flexible plastics packagings is limited to an appreciation of the criteria upon which a decision should be made between surface printing and "Reverse" or "Buried" or "Sandwich" printing.

Let us look at the main reasons why sandwich printing would be considered and them match those requirements against the performances which can be achieved using surface printing.

Sandwich Printing - Reason for Choice

1) To prevent scuffing of ink on the surface of a packaging due to abrasion during handling and transit.
2) To provide a very high gloss finish to the outside of a package.
3) By burying between two plies or adherends of a laminate, to prevent possibility of ink particles or solvents from contaminating the product contained.
4) To provide a bond between two adherends by using special "adhesive" inks in the form of an "Ink laminate".

Surface Printing

1) Prevents contamination of product by ink particles or solvents because all ink is outside package.
2) Gloss inks can provide a glossy surface to outside of package, but not as glossy as the surface of blown or calendered or oriented films when used as the outer ply of a laminate.
3) Can be in the form of a surface printed second ply in a duplex structure in which the two plies are not bonded, but both are heat sealable.

4) Can be provided as "scuff-proof" inks, which have high resistance to abrasion.
5) Can be overlacquered with a suitable lacquer to provide gloss and scuff resistance.
6) Can be provided as heat-resistant inks where heat-seal areas are printed.
7) Produces no residual solvent odour between the plies of a laminate.

In order to decide which is the most important attribute a dry bonded laminate should possess, let us list those we know to be important. We will then investigate their relative order of importance by applying a technique known as "Forced Choice Ranking". In this technique, we form an attribute matrix of rows and columns. Each attribute is listed, both vertically and horizonally, but not in any particular order, since this exercise is aimed at informing us of what the order of importance of those attributes should be.

If this test is applied honestly, most people will arrive at identical answers, because one is forced to make only one decision at a time. If the question is: "Is product contamination or the avoidance of it, a more important attribute for this laminate, than a highly glossy surface?, the answer must be given as either an unqualified YES, or an unqualified NO. There can be no interpretation or shades of meaning in the answer when applying this technique. The answer can only be either for or against all th others, working across each now from left to right down the table.

If you practice this technique several times you will find it is easy to use and extremely reliable results are obtained.

The only requirement is that your answer be an honest one. Either A is more important than B, or it is not.

If you will now examine Table 3 you will see that by Forced Choice Ranking. We have arrived at a reliable order of importance for each attribute.

This allows us to see that gloss is more important than scuff resistance, but neither of them is more important than: product contamination, heat sealability, bond strength or residual odour.

Table. For glossy dry-bonded laminates

FORCED CHOICE RANKING OF ATTRIBUTES

Yes = 1 No = 0

	scuff resistance	gloss	residual ordour	product contamination	heat sealability	bond strength	first rank totals	priority
Scuff resistance	0	0	0	0	0	0	0	5
gloss	1	0	0	0	0	0	1	4
residual ordour	1	1	0	0	0	0	2	3
product contamination	1	1	1	0	1	1	5	2
heat sealability	1	1	1	0	0	1	4	1
bond strength	1	1	1	0	1	0	4	1
checking totals	5	4	3	0	2	2		

By adding column totals to row totals

scuff resistance	5
gloss	5
residual odour	5
product contamination	5
heat sealability	6
bond strength	6

Notes ;

1. By adding Rows and Columns we obtain a check on the total score of each attribute.
2. Where equal scores occur, equal priorities exist.
3. First priority is allowed to the highest score.
4. Lowest priority is allowed to the lowest score.

Returning to our list of reasons for choosing a dry-bonded laminate in the first place, it can now be seen that if a surface ink is not glossy, when gloss is considered an important aid to sales, then sandwich printing should be used. There is another side to this problem and it, too, needs to be examined. How much difference in legiblity is there, (if any), between a Brand Name or Product Name when printed surface or sandwich? If legibility is improved by gloss, then gloss shoudl take precedence as a requirement, but if legibility (easy to read) is not improved by the presence of a high gloss, the question then resolves itself into one of obtaining scuff-resistant, glossy inks for surface printing.

This difference in appearance between surface printing and sandwich printing cannot be resolved by technical argument alone, nor can it be resolved by artistic or aesthetic considerations alone. One third consideration can be mentioned. If sandwich printing may cause the retention of residual solvent, that alone may be sufficient reason to decide to use surface printing with scuff-resistant, gloss inks.

9. Print Lamination

This technique was originally developed for low-cost lamination of two coated cellulose films for snack foods. The primary reason was to avoid residual odour from the solvents then in use in dry bonding. By using sandwich printing with special "adhesive" inks, a good bond could be secured, one which was strong enough to perform well in the field.

There are two criteria which must be observed when designing print laminates.

1. The ink coverage must be not less than 90% of the area to be laminated.

2. The inks must be adhesive to the coated surfaces of the adherends.

It is not necessary to confine the technique only to cellulose films. A little experimentation with combinations such as OPP/ EVA film-OPP/PE film, or OPP/IONOMER film may meet with equal success. It is also possible to combine polyester/PE, provided the inks used are compatible with both adherends and will dry or cure without retaining excessive amounts of ink solvent.

The proper place to obtain technical advice on the particular ink formulations is from the ink making company, who are the true experts in ink technology.

You should carefully avoid "ad hoc" experimentation with print laminating inks.

The chief advantages of ink laminates are;

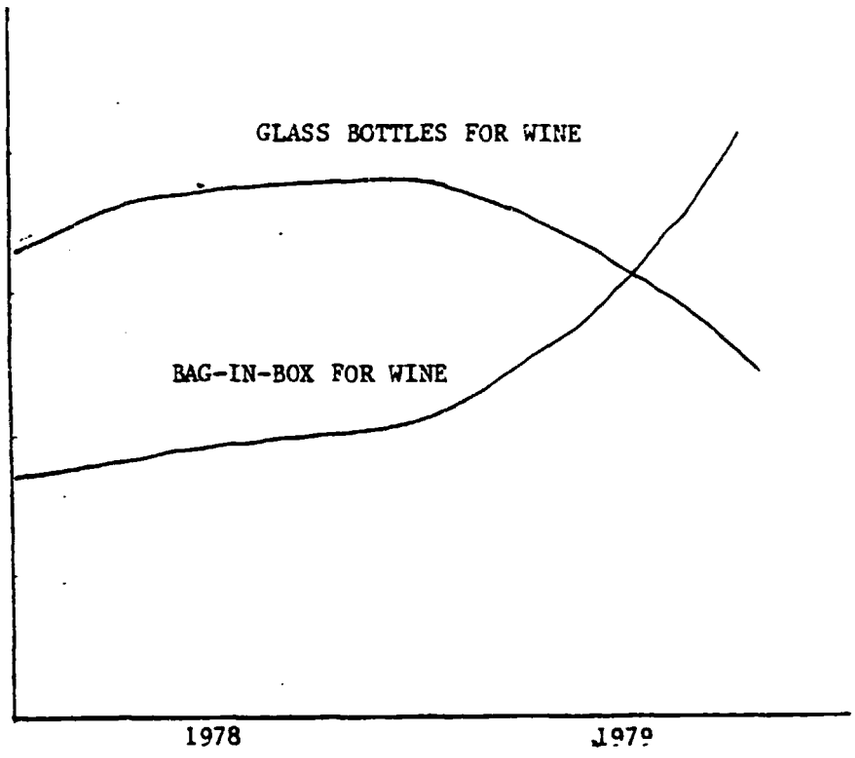
a) Lower cost than dry bond laminating.
b) Fast production speed.
c) Adequate bond strength.
d) Equal surface gloss compared with dry bonding.
e) Equal or better clarity through transparent area of surface design.
f) Fast passage through automatic packaging machines.
g) Good stiffness or "hand" (feel) when customer buys the product.

10. Duplex and Triplex combinations - unbonded

(The airlessflow bag-in-box for wine, milk, juice and yogurt)

The substitution of bag-in-box packaging for quaffing wines instead of glass bottles is a very interesting example of just how flexible packaging can operate to capture market share from long-established rigid packaging.

Consider the graph shown below, which refers to the wine market in Australia.



This is really a trend diagram rather than an accurate graph.

The flexible plastics Bag-in-box idea originated about 15 years ago and it has a number of very desirable features when used for packaging liquids.

a) Suitable for semi-bulk and bulk quantites from 1 liter to 50 liters
b) Due to the simple physical principle of Bernouilli's theorem, the flexible bag collapses under the pressure of ambient air, as the contents are dispensed through the spigot or valve.
c) This collapse of the bag ensures that no air enters the bag as it becomes progressively more empty and so there is no entry of oxygen to cause off-flavour of wine or rancification of the fats in milk.
d) The shelf life of wine can be maintained for at least 12 months provided both valve and flexible bag together have an oxygen uptake figure of less than $60cm^3$ of O_2 over a period of 12 months.

e) The cost of a 5 liter Bag and Box with valve is definitely competitive with 5 x 1 liter bottles with labels corks and capsule, and the plastic bag is not fragile like glass.

f) The packaging is easily disposable.

f) The flexible bag with valve provides a number of interesting possibilities for re-use.

1) As a cushion for picnics
2) As an air pillow when camping
3) As a portable container for drinking water
4) When filled with water and frozen solid, as a chilling block to keep food and drinks cold(or hot) for picnics, camping, hikes, etc.
5) As a miniature hydroponic garden
6) For dispensing Ice Cream hygienically

Economically, this bag-in-box package could represent large savings in packaged food or drink costs for large institutions, or government departments.

The equipment needed to heat seal the flexible plastics normally used in these packages already exists in several companies.

While these structures could be made by adhesive bonding, between the layers, separated layers, forming a multi-walled bag, have better stress crack and flex crack resistance and flexibility. Also, the ability for one layer to move freely relative to its neighbour under impact shocks means that unbonded structures can absorb more impact energy more effectively than bonded structures

DUPLEX STRUCTURES

For wine

metallised polyester 12μ/PE20μ
PE/PVDC film (30μ PE 12μ PVDC)
PVDC/PE film (12μ PVDC 30μ PE)
metallised polyester 12μ/PE 20μ)

For milk-fresh milk-maximum 3 days shelf life

metallised PE film 100 μ
PE.film metallised 100 μ

For milk (UHT)

metallised OPP 20 μ , PVDC 15 μ
PE film 30 μ
PE film 30 μ
metallised OPP 20 μ , PVDC 15 μ

For juices

same structure as for wine

TRIPLEX STRUCTURES

For wine

metallised OPP 20 μ
PE/PVDC film 20 μ , 12 μ
EVA film 30 μ
EVA film 30 μ
PVDC/PE film 12 μ , 20 μ
metallised OPP 20 μ

For wine or juices

BOPP/PVDC	20 μ, 12 μ
metallised PE film	20 μ
EVA film	20 μ
EVA film	20 μ
metallised PE film	20 μ
PVDC/BOPP	12 μ, 20 μ

For yogurt (liquid)

polyester/PE film	12 µ, 15 µ
metallised PE film	20 µ
EVA film	30 µ
EVA film	30 µ
metallised film	20 µ
PE/polyester film	15 µ, 12 µ

Appendix B

CRITERIA FOR SURFACE DESIGN (GRAPHICS) OF FLEXIBLE PACKAGING

The elementary requirements for package surface design are :

1. Package Shape
2. Apparent Size
3. Colour Usage
4. Product Name
5. Brand Name
6. Variety or Flavour
7. Price
8. Secondary Descriptive Matter
9. Ink in Heatseal Areas

If the Package is a rectangular prism such as a folding boxboard carton, these eight Design elements may be spread over all six faces of the rectangular prism. If it is a metal can, the elements are usually all printed on the curved body of the can.

This introduces some difficulty because only about 100 degrees of arc are legible to human eyes while reading the message which is printed on the package. The some comment applies to cylindrical or conical plastics packages which may be rigid, semi-rigid or flexible.

Our main concern today lies with flexible packaging, usually in the form of pouches, sachets, bags or automatic machine wraps such as are commonly used for biscuits.

Let us examine the visual identification problems which exist for the shopper when trying to purchase a convenience food such as a snack food, confectionery or a drink in a package such as Tetrapak, Doypack or simple vertical FFS pouch.

1. The shape of a flexible pouch is difficult to describe.

It is basically rectangular but it is not a prism. Rather it is an inflated rectangular object having Ogee curvature at each end of the body. The simplest non-technical description would be "pillow pack" although that term does not take into account the presence of the fin seals at each end.

The proportions of length to width are quite important from an aesthetic point of view and they are equally important from an economic point of view. An example is given.

This pouch (Tong-Yang Animal Cracker), 175mm long x 120mm wide has a face area of 0.021m^2 and it will use a web of material on the printing press, of either 280mm for "1 up across", 540mm for "2 up across" and 800mm for "3 up across". While "4 up across" would use 1060mm.

The number of print images around the cylinder is not important here. This design is printed with baseline of the type matter, parallel to the machine direction.

Most rotagravure printing machines used in Korea at present have a maximum printing width of about 1100mm. In our example a web width of 1060mm would utilise 96% of the printing width capacity. The machine is using 25 horsepower or 18,650 watts of power, regardless of the amount of printing width utilised.

This package (HAITAI Matdongsan) is 180mm long x 130mm wide. It will not fit 4 up across an 1100mm printing width because each pouch uses a width of 280 + 20mm for edge trim. 280 x 4 = 1120 + 20 = 1140mm. We are therefore forced to print it only "3 up across". This (280 x 3) + 20 being equal to 840 + 20 = 860mm web width.

Now 860mm is only 78% of the available printing width capacity. This means that 22% of the electrical energy which must be used to run the printing machine will be wasted.

A slight change to the length and width of this pouch would therefore enable a more efficient web width to be run. It is not very likely that such small changes to pouch dimensions would represent any problem in regard to the width of sealing jaws on the packaging machine. Even if it did,

the purchase price of a new set of jaws could be recovered easily within a few months through more efficient production.

The sensible approach, then, is to design the aspect ratio of the pouch (length divided by width), in accordance with the available maximum printing width of the printing press which will be used.

These sketches will show that it is possible to produce a very large number of families of pouch aspect ratios, and within each aspect ratio, a large number of pouch sizes.

When the printing width is taken into account first, the effect of waste is controlled. Cause and effect must always be recognised together and worked upon together.

2. Apparent Size

The optical and visual aspects of retail consumer goods packages obey physical laws which are well-known and have been very widely reported in the literature. When a shopper passes along the aisle in a Supermarket, or stands in the small corner shop, the surface graphics on the package which is being read is usually about two metres distant from the shopper's eyes. The shopper does not read from this distance, he or she recognises shape and contrast with the background, of the largest or most compelling element of the package design. This may be the shape of the package itself, or the Brand name or Product name, or the main mass of colour.

These recognisable shapes, colours and symbols are only recognisable through familiarity with a particular package.

If the package is a new, or unknown one, the shopper may fail to detect its meaning, although he will be aware of its presence.

The way to stop the shopper so that he may reach out for the package to pick it up and read the message, is to make it sensibly large in appearance and of a colour which will make it stand out from its neighbours and the overall background.

Whatever the shape may be, he will recognise or identify it at least as much by its appearance of size or bigness, as he will by virtue of its colour or shape. The mechanisms of recognition, perception and identification are fully reported in the literature of psychology. Size is recognised to play a large part in the provoking of impulse purchases, and the apparent size of a given package when compared to its immediate neighbours, is considered by many to be one of the most important determinants of initial and repeat purchases.

The principal foci for attention are provided by:

a) Apparent height
b) Apparent volume
c) Apparent colour
d) Depth of contrast of colour elements
e) Gloss

All of these attributes are directly related to apparent size.

Actual size is often very much less than apparent size. Some packages are deceptive in this respect. They are quickly recognised as being deceptive. If they contain basic foodstuffs they will not be bought. If they contain leisure or convenience products, they may be bought using "leisure" or "convenience" purchasing power for pleasure or esteem but the deception will be clearly recognised and it is often resented.

Apparent size must therefore be designed into a package. When dealing with flexible packages, the flexibility of pouches often distorts the apparent size. Package evaluation techniques exist which enable one to form an accurate judgement on the cause and effect of apparent size.

3. Colour

The use of colour on retail packages is not always properly understood by those who are most involved-Designers, Printers, Supply Managers, Marketing Managers and Salesmen.

Consumers are excellent judges of the appetite appeal of colour. This common ability to respond to colour is seen most readily in clothing and fashions, but it exists with equal force and reality in packages intended for retail sale.

Good package designers have to be truly expert in their understanding of the commercial, social and poetic effects of colour. A well-known expert in colour, has described common colours in poetic terms very similar to these.

Yellow is like a triangle standing on its apex. It is a happy colour, highly attractive to children and adults alike. Yellow connotes the warmth and the light of the sun. Orange is like a rectangle standing upright. It, too, is a warm, vibrant, substantial advancing colour. Orange gives a sense of reliability and a pleasant tactile impression.

Red is like a square, solid and secure. Red is the colour of danger and attention. Despite this, red type matter is not very legible. Red is hot, dry, compelling. It is the colour of war and of sex. If you wish to attract the shopper's eye, use red.,

If you wish to hold the shopper's attention, be sure the total amount of red on the package is less than 40% of the main display face area.

Green is like a hexagon, Cool, Crisp and Fresh. Green, too, is a happy colour. Bright green is a colour which refreshes the eye and the mind equally and at the same time. Eye appeal occurs when the eye and mind are startled and pleased simultaneously. Green can do that when it is used properly in package design.

Blue is cool, and infers circular shape. It is wet, retiring, often bright and vilrant, sometimes distant and retiring. The use of blue often enables a package designer to introduce smooth curving influences to soften the stridency and harshness of words prited in strong dark colours such as brown or black, having angularity and sharp, hard edges.

Violet is like an oval or ellipse. It is misty, distant, vague and sometimes wispy. Violet need not be intense to be effective. It is a soft, swirling, clinging colour which has the effect of smoothing the effective

clash between other strong colours used for attention and substance in a package design.

Yellow, Red and Orange and advancing colours. Green, Blue and Violet are retreating colours. Black and White are used for attetion, contrast and intensity. As in advertising, large areas of white illuminate the selling message.

The proper choice and use of colours in package surface design is a very demanding discipline. It calls for considerable restraint on the part of the Designer.

Bright primary colours draw attention. Complementary colours balance the overall effect. Shades, tints and tones of primary colours permit modelling and blending of the strident aspects of commercial selling which must be present in an effective surface design.

Shades, tints and tones of secondary colours lead to muddy, uninspiring colour effects; and results at point of purchase are often disappointing.

Analogous colours, being usually tertiary colours, are extremely difficult to handle. Only in exceptional circumstances does a product need analogous colours on packages for low-order, high-volume consumer packages intended for retail sale in supermarkets and department stores.

4. The Product Name

Retail packages, when displayed at Point of Purchase, must do several things effectively. They must draw the attention of the shopper, identify the product, qualify the variety or flavour and last but not least, inform the shopper of the amount contained, the cost, and therefore the value received for money spent. For well-known products, seen everywhere, the Product name is usally given greater prominence than the Brand name.

This is because consumers buy products in order to eat them or use them. When similar products can be bought in similar packages at similar prices,

the source or origin of the product is of secondary importance to the initial recognition of the product itself. Once the product has been identified by recognition of the product name, then the Brand name may become very important. Some packages emphasise the Brand name more than the Product name. This could be a mistake.

The Product name should be printed at or near the optical center of the main display face area.When the main display face area is between 200 cm^2 and 500 cm^2, the product name should occupy about 10 % to 25 % of the available area on that face of the package to ensure good visual impact.

5. The Brand Name

Consumers place an enormous amount of faith in the quality of a packaged product made by a well-known company.

The presence of a Brand name on a package is always necessary and sometimes mandatory for legal reasons.

Brand names are usually stylised and many have been registered as Trade marks.

Continued use of both product name and brand name over many years can build consumer loyalty and repeat sales.

Brand names should be supportive of the Product name rather than subservient to it. The choice of printing a Brand name in a fixed position on all of the packages in a range or family of products has much to commend it, but such practices should not be regarded as inviolable. There is always the possibility for justification of changes to the size, colour and Positioning of a Brand name, but seldom any justification for printing a Brand name in different type styles or sizes on different packages.

Brand names, like Product names, have "Shape of Recognition" and this should not be interfered with, or the value of the "Mark" may be lost.

6. Variety or Flavour (Primary descriptive matter)

This element in a surface design exercises a dual function.

It must identify the colour of the product, the flavour of the product or the particular quality or attribute which is being sought by a shopper. So it must perform an identification function. It must always be seen to be, at the same time, one of the elements of descriptive matter in the total typographic message. For both these reasons, the way in which it is printed or handled can make or break the success of a package surface design. Variety or flavour should appear on the main display faces, but unobtrusively.

It must be printed in a colour or colours which are legible and offer a satisfactory contrast to the background within which it appears. In type size, it should not overshadow the Brand name.

7. Price Indication (Primary descriptive matter)

Most packages carry the price information in a flag or cartouche or a sunburst on the main display face, and that is good practice. The method of dealing with the typography of the price should be such that it does not offer registration problems for the printer. Price spots should be functional, not artistic. If a sunburst is used, it should be a simple one - colour sunburst. Edged or outlined or bordered sunbursts are a nuisance to the printer and are not more legible than plain sunbursts.

Use simple, sans serif type faces for the numerals in a price spot.

8. Secondary Descriptive Matter

Much of this information is mandatory and is imposed on product manufacturers by force of law, to protect the public interest.

The printing of these elements of the surface design should therefore be kept as simple and as legible as possible.

In gravure printing and in flexographic printing, the sawtooth edge and the squash, which are characteristic of these methods of printing

respectively, may cause the information to be illegible if the type size choice is too small or if the letter strokes are too narrow, or too wide.

It is wise to use a letter stroke width which is at least as wide as two lines of dots for gravure printing and at least as wide as the squash on each side of a letter stroke when printing by flexography.

9. The Use of the Heat-sealed Areas as Design Elements

It is fairly common practice in Korea and elsewhere for designers to insist that the heatsealed fins at each end of a flexible pouch or FFS wrap are printed in colour, often with 100% ink coverage. It is also common practice to leave the back seam unprinted. What is the real reason for this difference in treatment?

Heatsealing over inked areas causes ink buildup on sealing jaws, it often melts or discolours inks which are not heat-resistant and in many cases crimping jaws are used, which completely change the appearance of the printing due to crushing, crimping or the impressing of the weave of the teflon-coated glass cloth used over the sealing jaws on some wrapping machines.

If the surface design is a continuous one, with full wraparound of the printing cylinder, the presence of ink in the cross-seal areas may be acceptable. But if the surface design is of a discrete nature, limited in shape and area to the shape and area of the body of the package, there is not much justification for printing the fin seal areas.

Except on transparent flexible packages, the eyespot is not a disruptive visual element, and in these cases most certainly it is possible to use an eyespot in other positions in some open designs.

The principal trouble with printing in heatseal areas is the buildup of degraded ink on heatsealing jaws leading to a risk of faulty seals. Since backseams are not printed, any they actually split the printed design on the back of such packages effectively into two separate panels visually, why cannot unprinted cross seals be treated as neutral colour areas of the surface design?

Good treatment of appearance, to cover up or justify bad practice is not good package engineering.

It is not good production practice, either.

Conclusion

Good practice and careful attention to every detail will result in good packages, increased market share and expanded consumer confidence in pre-packaged goods.

Appendix C

DESIGN CRITERIA FOR FLEXIBLE PACKAGING

This topic is important because the end result of all the Design and Production endeavours becomes manifest at point of purchase.

Any inherent vices which may have been designed into the package or which may have become built into the finished package during the preparatory, the production and/or the distribution phases will affect the appearance or quality and therefore the saleability, of the packaged product.

The major vices or faults which are found in flexible packaging, as in all other packaging, relate to:
Product, Material and Form. The Product problems may be due to breakage of frangible products such as biscuits, rancification of oils and fats due to degradation caused by actinic light, loss of crispness in snack foods, cereals or biscuits due to moisture uptake;or deleterious effects on other classes of products due to moisture uptake or loss.

The amount of freespace which is present and has to be provided when packages utilise pressure-formed trays as are now commonly-used for biscuits, nibbles and such should be carefully controlled. Although the packages may appear big at point of purchase, that appearance will come under increasingly closer scrutiny as being a form of deceptive packaging.

Materials will be covered by discussion in enough detail in other parts of this lecture, so I will not deal with details here.

The surface design is one of the most important aspects of FORM to be considered and discussed and it should be clearly understood that each aspect (Product, Material, From) becomes the dominant consideration at different times throughout the life cycle of an individual package as well as through out the life span of the product itself as one product in a company's range of products.

Product life spans may cover periods of time from 3 months to 30 or 40 years. Package life spans usually from 1 week to a maximum of about 2 years shelf life.

The total performance of a packaged product is what interests the consumer and surface design is only one aspect. We have evaluated seven Korean packages and we have given them scores for their ability to perform effectively as packaged products, from the time the product is prepared or processed in the factory, until the package has been finally disposed of either by recycling, by incineration or by being used in land-fill reclamation.

The system used for marking and scoring has been used for about 18 years and is quite reliable. In this instance, in order to avoid causing embarrassment to the companies which convert, and the companies which own, these packages and brand Names, we have codified the series of 7 packaged products.

The results quoted in writing will therefore not be revealed as identifying a given package;but under a code letter, the strong and weak points will be revealed, so that you can benefit from an appreciation of the important interdependencies which exist between the major aspects to be considered, namely, Product, Material and Form.

SCORE RANKING

a) 65.00 % effective
b) 61.33 %
c) 59.67 %
d) 57.33 %
e) 56.33 %
f) 53.67 %
g) 52.67 %

Notice that the best package in only 65% effective for the job it is expected to do, and that the span of effectiveness is within a range of about 12%.

A really good package will rate between 75% and 80%. Notice also, that four out of the seven packages evaluated scored least in surface design factors: while the other one scored best in design factors, two were marginal. This is in accord with such findings in many other countries. When carefully evaluated by using weighted numerical scorings such as those shown here, package surface designs show out as being only about 50-65% effective, and design factors usually score worse than consumer factors or physical factors.

Which leads me now to show some slides and allow you to decide whether my comments on aspects of these surface designs and packages are valid.

These slides are not shown in any relationship to the codification of the evaluation sheets you have been given.

Appendix D

EXTRUSION COATING AND LAMINATING

There are five aspects to be considered here.

1) The nature of the product, when it requires strong, hermetic heat seals, calls for a coated film or a laminate having either LDPE, or EVA, or IONOMER as the sealant. Extrusion coating and/or laminating can provide that feature better, more easily and more cheaply as a cost per unit area for a given performance level than can other methods of coating and laminating.

2) Transparency may, or may not be, a critical factor. Ultimate transparency is seldom a truly critical factor although it may be claimed by the designer that it is critical.

3) Sandwich or reverse printing may be considered to be highly desirable. Once again, the arguments for and against surface printing should be examined, because many products, being low cost, low-order goods, cannot justify reverse printing on economic grounds.

4) Adhesion of the adhesive to the adherend or adherends, either when coating or laminating, is best promoted by Corona discharge treatment. Adhesion promoters which take the form of an applied coating are never as effective as simple corona discharge treatment, mainly because there are fewer process variables to go wrong when using corona discharge treatment.

5) When all things are taken into account, extrusion coating and laminating have much to recommend them over wet or dry bond adhesive lamination or the so-called "solventless" or hot-melt coating or laminating techniques.

Appendix E

DRY BOND LAMINATING

1. Adhesive application factors (on machine)

   a) Pot life-particularly important for 2 component adhesives
   b) Solids/Viscosity
   c) Transfer to travelling web
   d) Wettability of adherend
   e) Wettability of dry ink on adherend
   f) Types of solvents - MEK, Ethyl Acetate, Toluol
   g) Control of application of adhesive
   h) Clarity

2. Characteristics applicable to the drying function

   a) Flow out of adhesive
   b) Solvent release
   c) Curing margin (50% above drying temperature)

3. Characteristics applicable to the combining function

   a) Initial tack of adhesive
   b) Fast cure of adhesive (2 to 5 days)
   c) Combining temperature (temperature of films in NIP)
   d) Transfer - manner of bonding to second adherend
   e) Clarity
   f) Ultimate bond strength

4. End - use application requirements

   a) High ultimate bond strnegth
   b) Stability against "Piping" or "Tunnelling"
   c) Chemical resistance
   d) Thermal resistance (heat sealing and reheat to serve)
   e) Aging properties
   f) Stiffness or machinability
   g) Flexibility
   h) Low odour
   i) Clarity
   j) Acceptable cost - a function of yield

PRODUCT REQUIREMENTS

1. Candy, snack foods, products packed on FFS machines,dry powders

materials

a) Polymer coated cellulose films
b) Polyester
c) 1 side coated cellulose films
d) Polyethylene
e) Polypropylene
f) PVDC coated specialty papers

product requirements

a) Good clarity
b) Good heat resistance for forming and filling
c) Stability against piping or tunnelling

2. Vacuum and gas flush packaging for: meats, cheese, non-critical heat in-pouch products

materials

a) Polyester/ PE or PVDC
b) Cellulose film/PE or PVDC
c) Nylon
d) Nylon / PE or PVDC
e) Polyester
f) Polyethylene - both low and medium density

Product requirements

a) High bond strnegth
b) High degree of resistance to piping or tunnelling
c) High chemical resistance
d) High thermal resistance

3. Boilable and autoclavable pouches

Materials

a) Uncoated polyester
b) Aluminium foil
c) Polypropylene
d) High density polyethylene
e) Medium density polyethylene

Product requirements

a) Very high ultimate bond strength
b) Very high heat resistance
c) Exceptionally good chemical resistance at high use temperatures

4. Difficult - to-package products : for antiseptic powders and liquids, tomato paste, liquids, oils and lotions, towelettes, surgical and medical products.

Materials

a) Polyester
b) Nylon
c) Aluminium Foil
d) Zero porosity papers
e) Ionomer
f) Polypropylene

Product requirements

a) Extreme chemical resistance
b) Extremely good aging characteristics
c) High strength bonds to specific substrate or midstrate

Appendix F

MATERIALS PROBLEMS

The problems which are normally encountered with flexible and plastics packaging materials are reducible for purposes of discussion, to four categories :

1) Physical properties, structure and surfaces which may be incompatible with other materials commonly used in combination.

2) Defects of quality and appearance which occur during manufacture of the given material, particularly when such materials are normally used in a partially-converted or fabricated form, such as plastics films or papers or paperboards.

3) The condition of the material when it is not partially-converted. This refers to materials such as the components of inks before thet are mixed together, e.g., solvents, pigments or resin binders; to plastics resin granules which may or may not include specific additives, to papers which may have different kinds of treatments applied to them, either within the structure of the paper or paperboard or to one or other of the two surfaces. These physical property conditions apply also to plastics films, laminates or combinations of flexible or semi-rigid materials, whose surface condition must be such that specific purposes will be fully and properly achieved. A good example of this is the presence and the performance achievement of heat-sealable coatings or heatsealable films used in flexible laminates and packages.

4) This category deals with the suitability of a material to perform the designated task or function fully. Compatibility of materials to be combined for specific purposes will either be known in advance, or it will have to be established by experiment in a laboratory under controlled conditions - Field trials are not sufficiently exact or reliable. First conduct laboratory tests, and then, based on the results of those tests, design field trials. Never do it the other way around.

Defects of quality can only be checked and corrected after measurement, either by metrology or by instrumentation or by shelf life testing under controlled conditions, or by statistical analysis of rejects.

Defects of appearance are usually found and controlled by subjective means such as visual assessment. Colour matching should be done by instrumentation, that is by using a colorimeter, or a spectrophotometer or a density scale. Such things as colour, smoothness, gloss, reflectance, emissivity (metallised films) and ink receptivity should all be checked by instrumental techniques, not by visual, auditory or by tactile techniques.

The condition of a material includes such things as chemical purity, chemical and physical cleanness of the surface, miscibility, proportion, exothermic or endothermic results, moisture content, solids content, contaminants and plasticisers or other treatments and additives which have been included for specific reasons. Heatseal coatings or plys are an example of this.

Suitability to perform is normally found, as already stated, either by prior knowledge, by a literature search, or by laboratory investigation. Suitability to perform the required function includes the ability to do so at an acceptable and economically viable cost.

These few slides show some faults in heatsealing. In every case the fault lies with the machinery and the conditions under which it was operated. In no instance shown here, was the material faulty, or a wrong material.

Appendix G

PRINTING PROBLEMS

Several aspects will be discussed here because they are commonly seen in Korea as well as in many other Asian Countries.

1) Designs which make use of very close positional register with colour overlap areas which are too narrow-this causes lower machine speed and high rejection levels of printed materials.

2) Too much ink coverage - as much as 250-280% ink coverage can be found on some flexible packages - Why pay for expensive transparent packaging materials and then cover them with an excess of ink ?

3) If opaque inks are used, often a white backup colour is not needed - If you wish to have a good background to your overall ink colour consider using metallised film with the metal surface facing or in contact with the ink surface - This will give better opacity and reduce the total amount of ink to be used, so reducing problems caused by retained ink solvents. It may also increase eye appeal or legibility.

Colour contrast is the most important factor controlling legibility. (easy to read). Although clean and effective typography in English language, and calligraphy in Hangul language; are very important for Brand Name, Product Name, and descriptive matter on packages, colour contrast, colour balance and pleasing colour are just as important.

Therefore the printed design must be favourable to ease of reading at the same time as it startles and pleases the eye of the customer. The order of printing colours can make a design successful or unsuccessful. This matter of choice of print colour order should always be negotiated between the package designer and the printing room supervisor. It would never be decided by either one of those two persons alone. Each needs the benefit of the other's expertise.

Material waste which occurs in printing shops due to excessive trim off the edges of rolls, and printed roll widths which are not aliquot parts of printing cylinder widths are the two most common causes of hidden costs in printing for flexible plastics packaging.

The last matter I shall refer to here concerns the correct maintenance of printing machinery. A package designer cannot be expected to act as an engineer in regard to printing machine maintenance. But he can be expected to insist that his work shall be printed on machinery which is regularly cleaned, so that rotating surfaces, bearings, screw threads and similar parts of the machine are kept clean so that they remain bright and shiny.

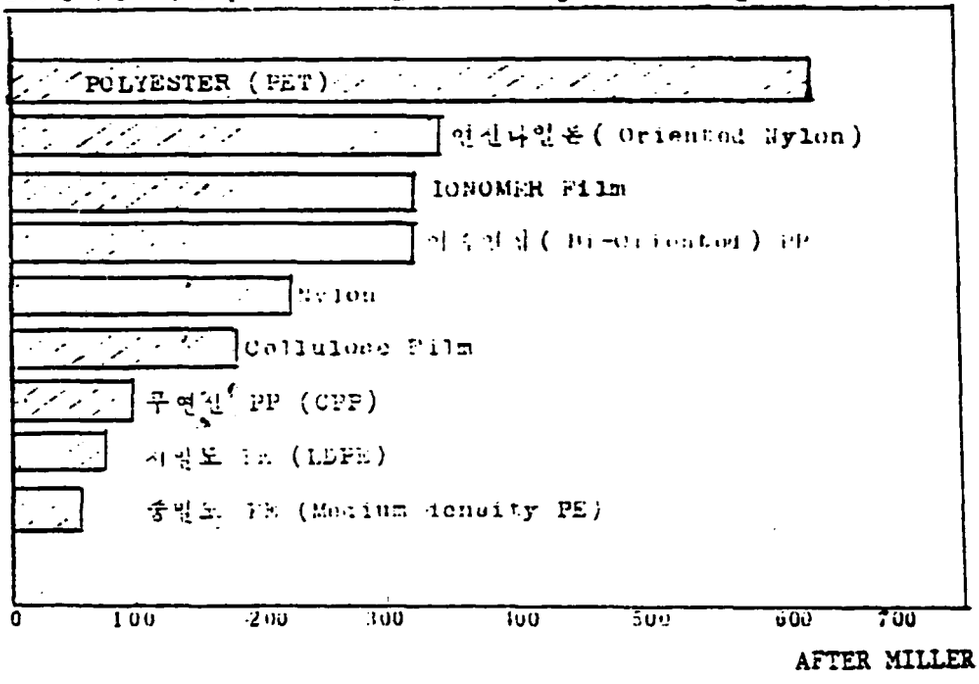
Finally, training first in the theory of printing and then education in the practice of printing should be compulsory subjects for package designers before they are allowed to create designs which must be printed. You would not use a taxi if you knew or felt the driver did not understand the rules of the road, so why use a designer who does not fully understand the rules and detailed practices in printing ?

APPENDIX H

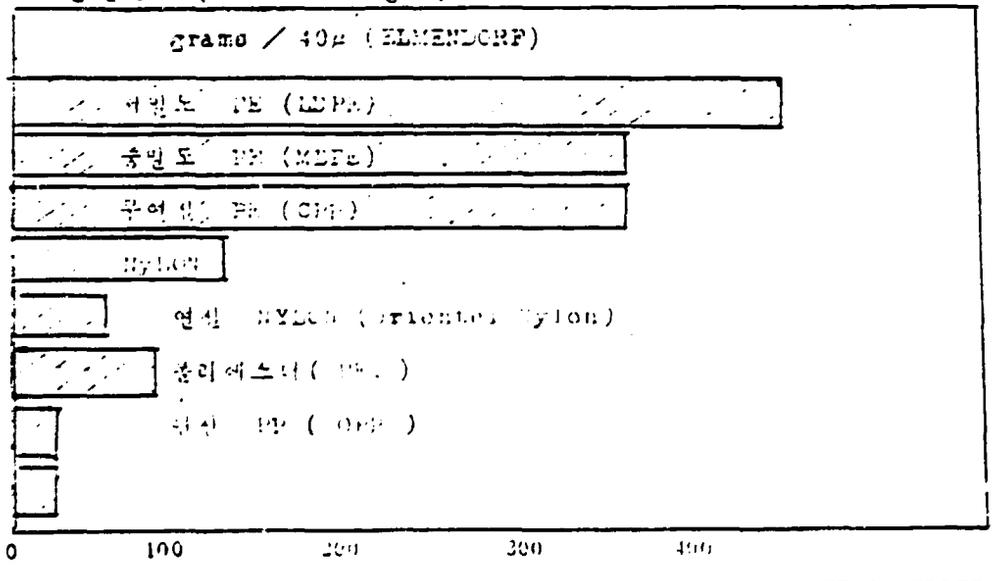
Physical Properties of Flexible Plastics

Packaging Materials

1. 충격강도 (impact Strength) - Single films (grams/20μ)



2. 인열강도 (Tear strength)



3. 구조적 안정성 (Dimensional Stability) Single films

가. 폴리에스터 (PET)

나. 폴리에틸렌 (PE) film

다. 폴리프로필렌 (PP) film

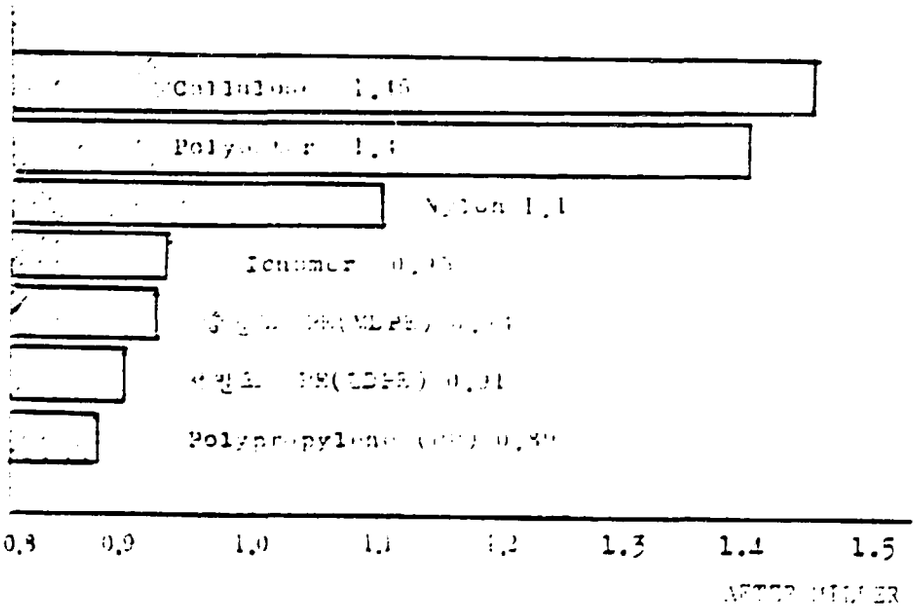
라. 이오노머 (Ionomer) film

마. 나일론 (Nylon) film

바. 셀룰로오즈 (Cellulose) film

4. 밀도 (Density)- Single films

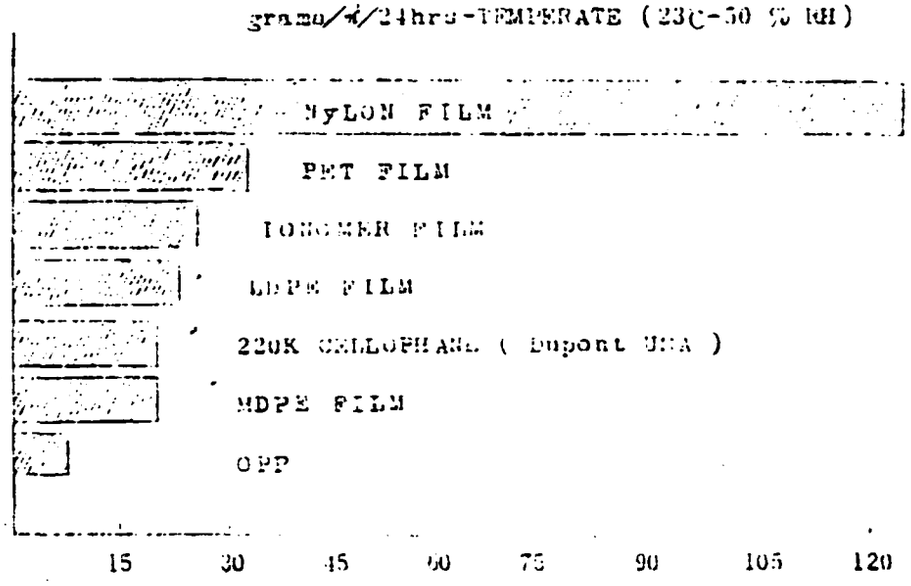
grams / ㎤



AFTER MILLER

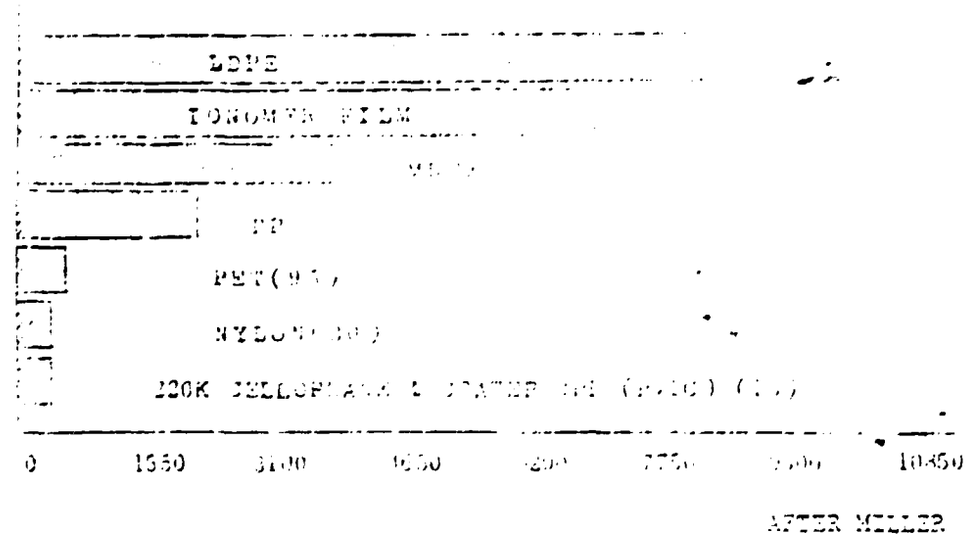
5. 습기 투과율(Moisture Vapor transmission rate)

grams/㎡/24hrs-TEMPERATE (23℃-50 % RH)

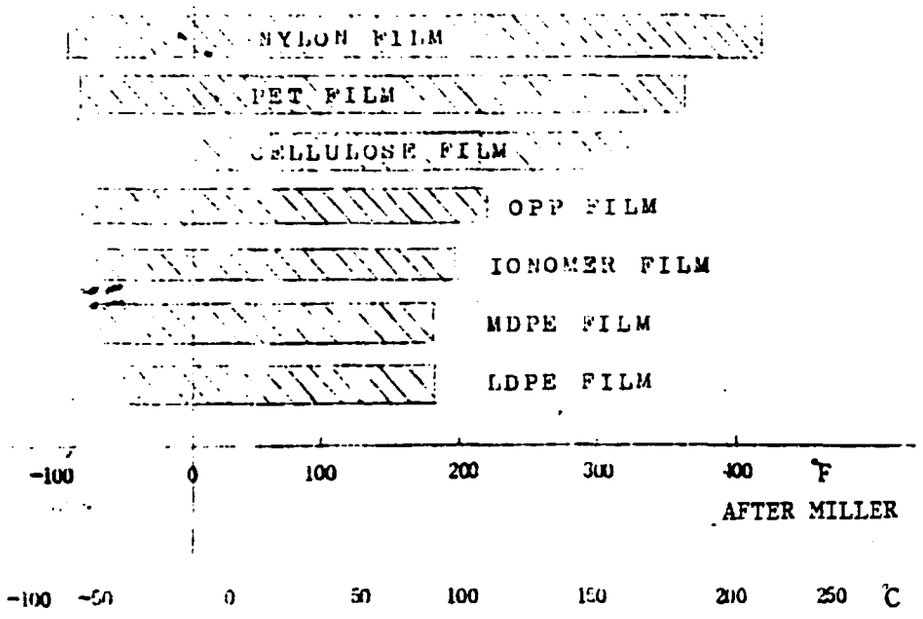


6. 산소 투과도(Oxygen Permeability)

㎖/㎡/24hrs/atmosphere



7. 실용온도 범위 (Practical use Temp. range)



8. 내유도 (Grease resistance Rating)

가. MXXT Cellulose film

나. PET film

다. Nylon film

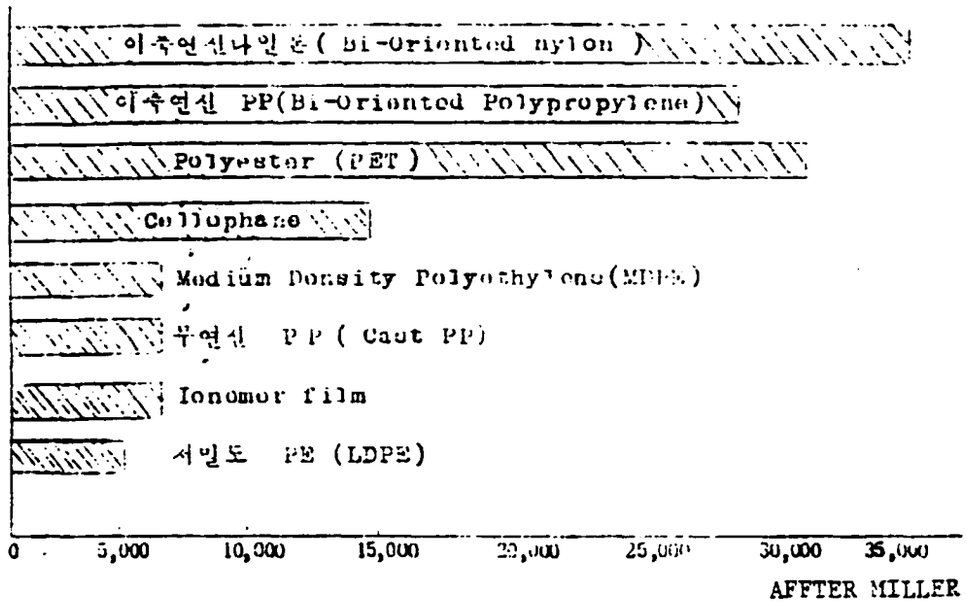
라. Ionomer film

마. PP film

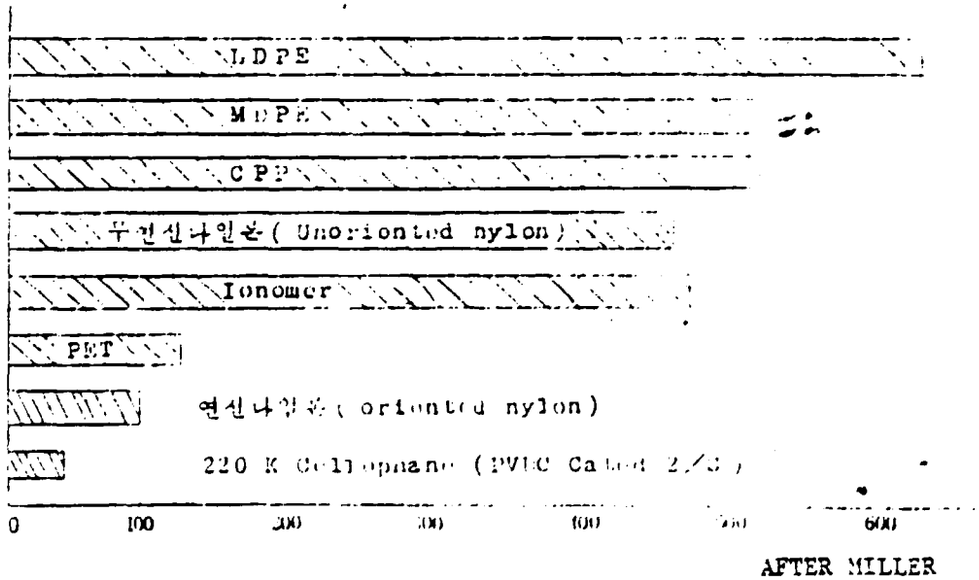
바. MDPE film

사. LDPE film

9. 인장강도(Tensile Strength) - Single films (lb/in^2)

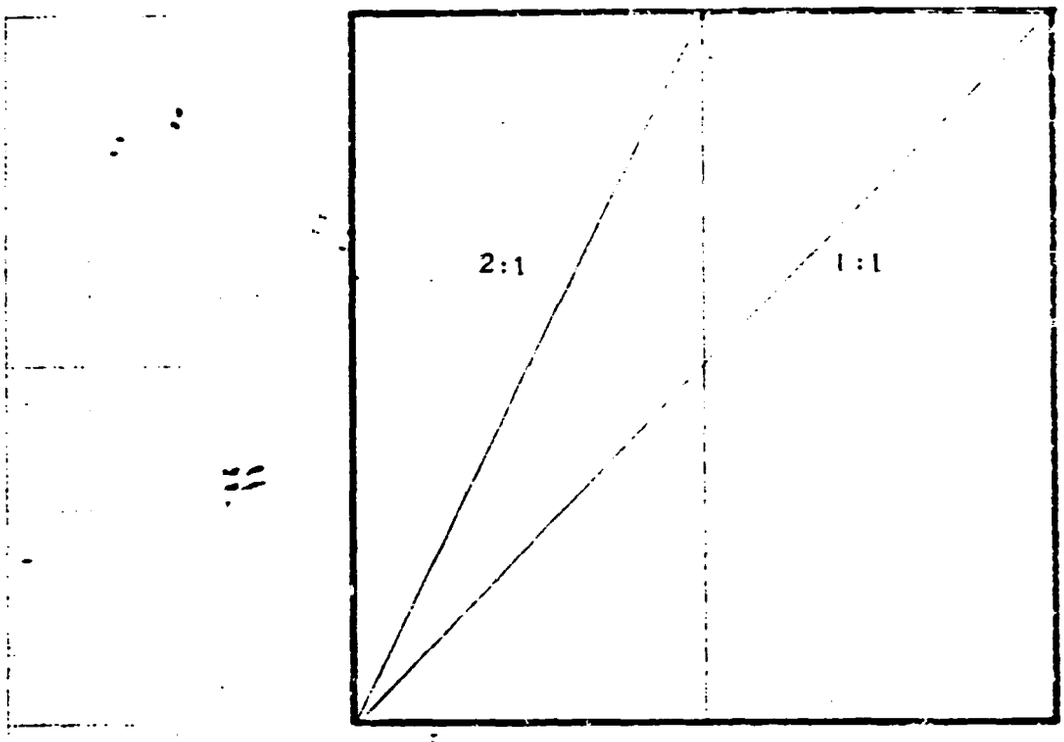


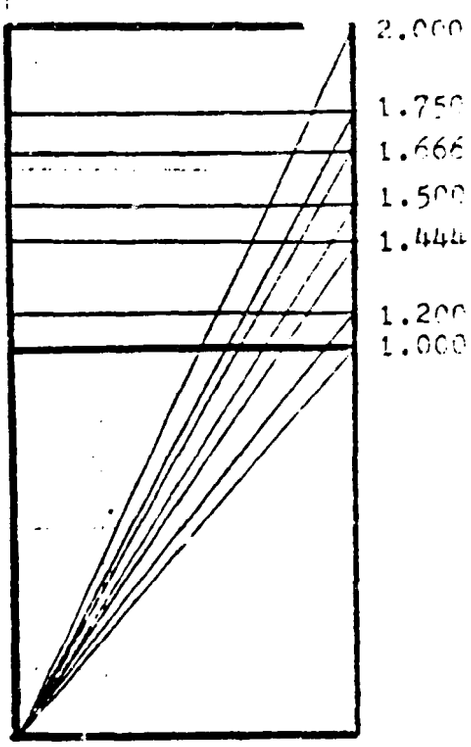
10. %신장(Percent elongation) - Single films

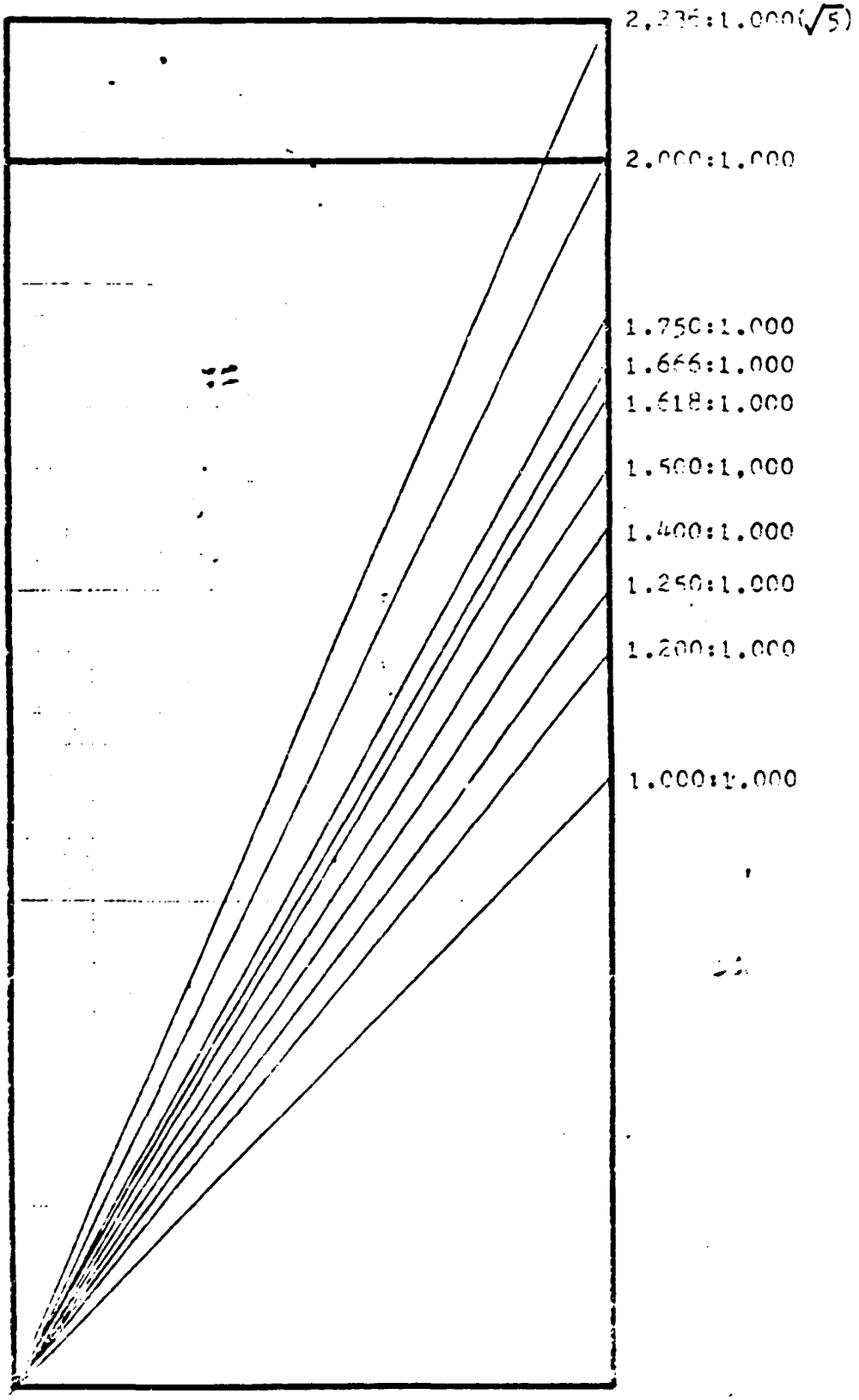


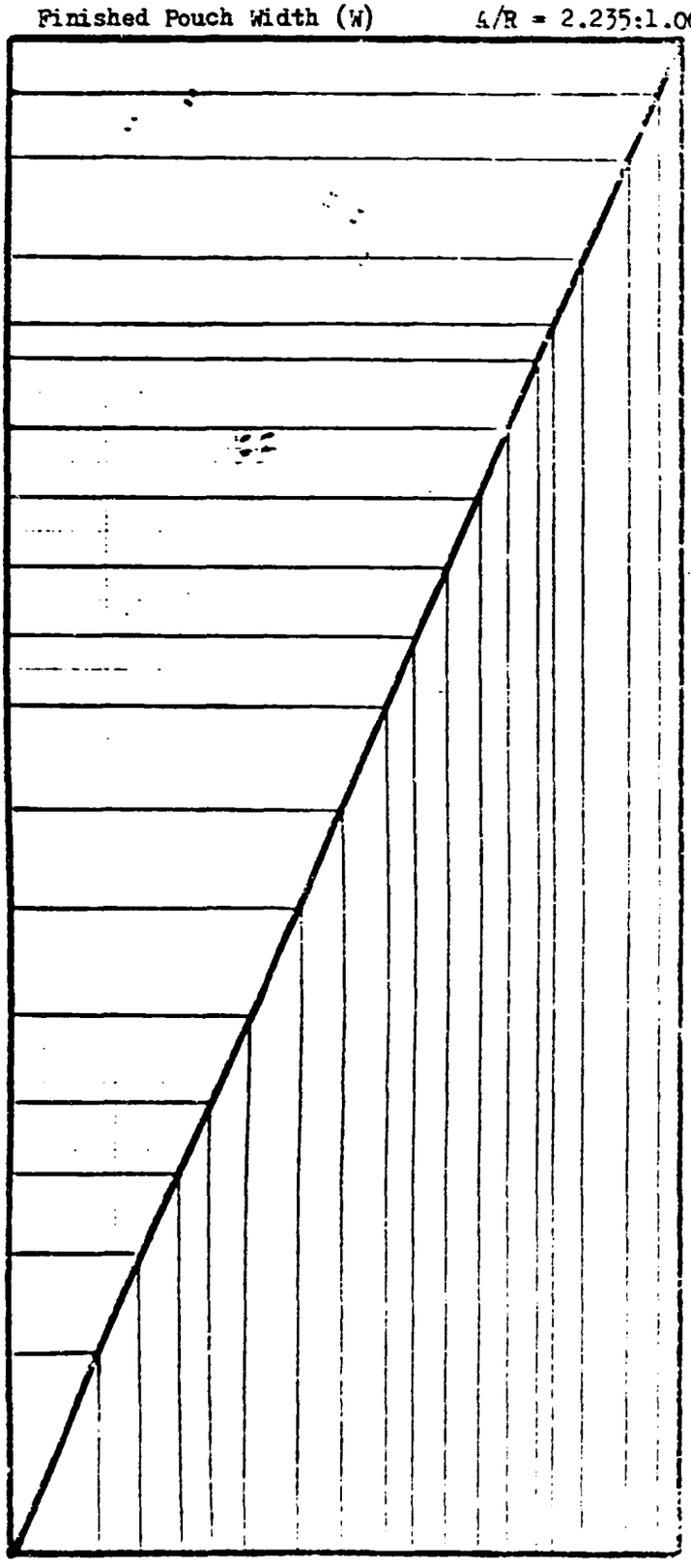
APPENDIX I

FLEXIBLE POUCH ASPECT RATIOS (A/B)






2.236:1.000($\sqrt{5}$)
2.000:1.000
1.750:1.000
1.666:1.000
1.618:1.000
1.500:1.000
1.400:1.000
1.250:1.000
1.200:1.000
1.000:1.000



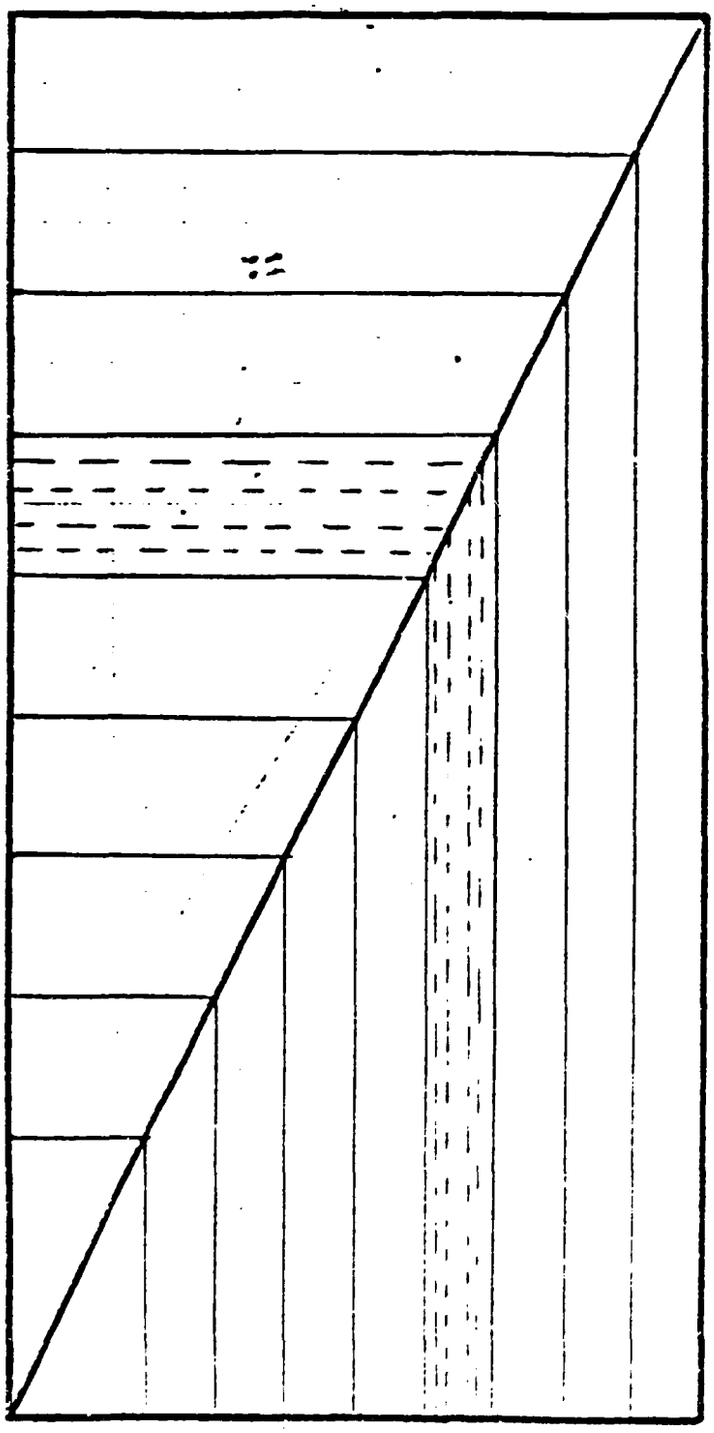
Finished Pouch Length (L)

L = Cutoff length of pouch

W = Slit width of web

Not to scale

Finished Pouch Width (W) A/R= 2.000:1.000



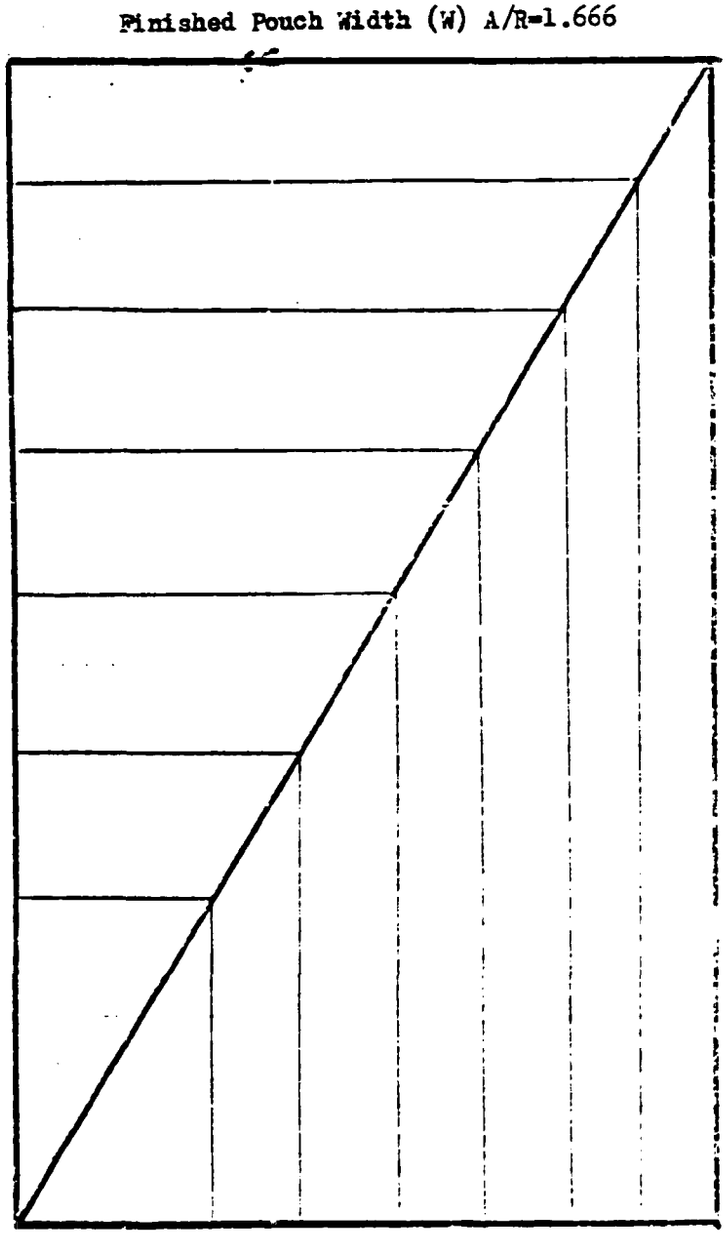
-----;Optional sizes

Finished Pouch Length (I)

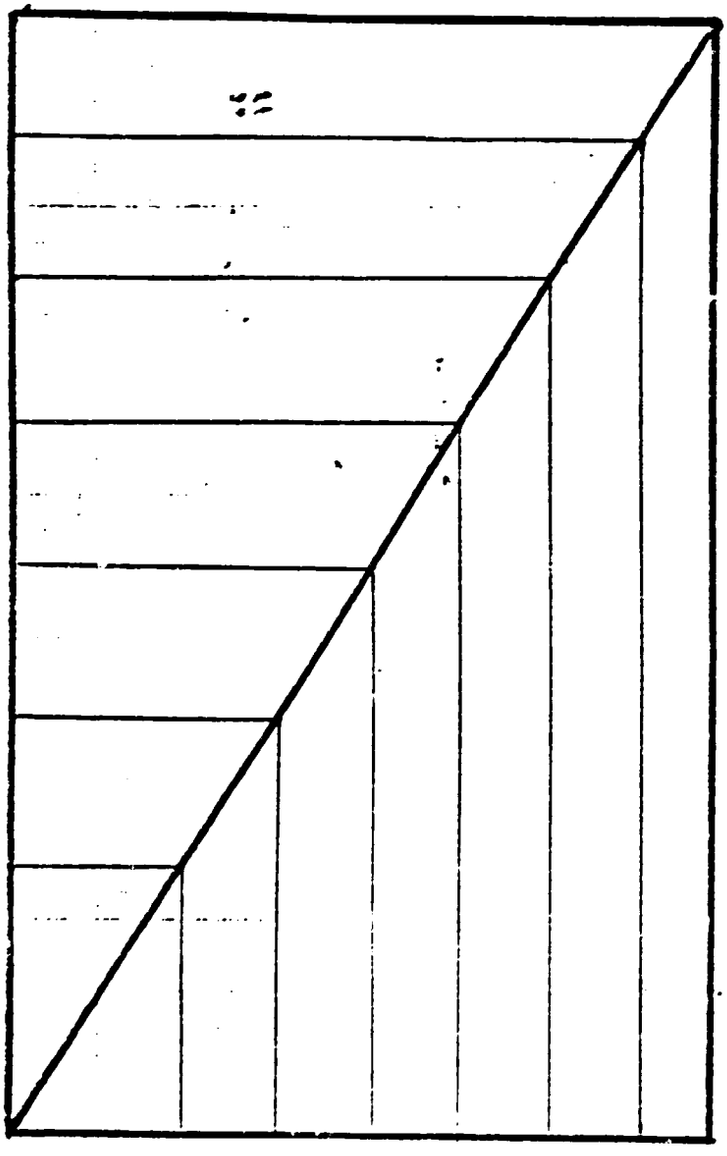
L= Cutoff length of pouch

W= Slit width of web

Not to scale


Finished Pouch Width (W) A/R=1.666
Finished pouch Length (L)
L = Cutoff length of pouch
W = Slit width of web

Finished Pouch Width (W) A/R=1.618:1.000

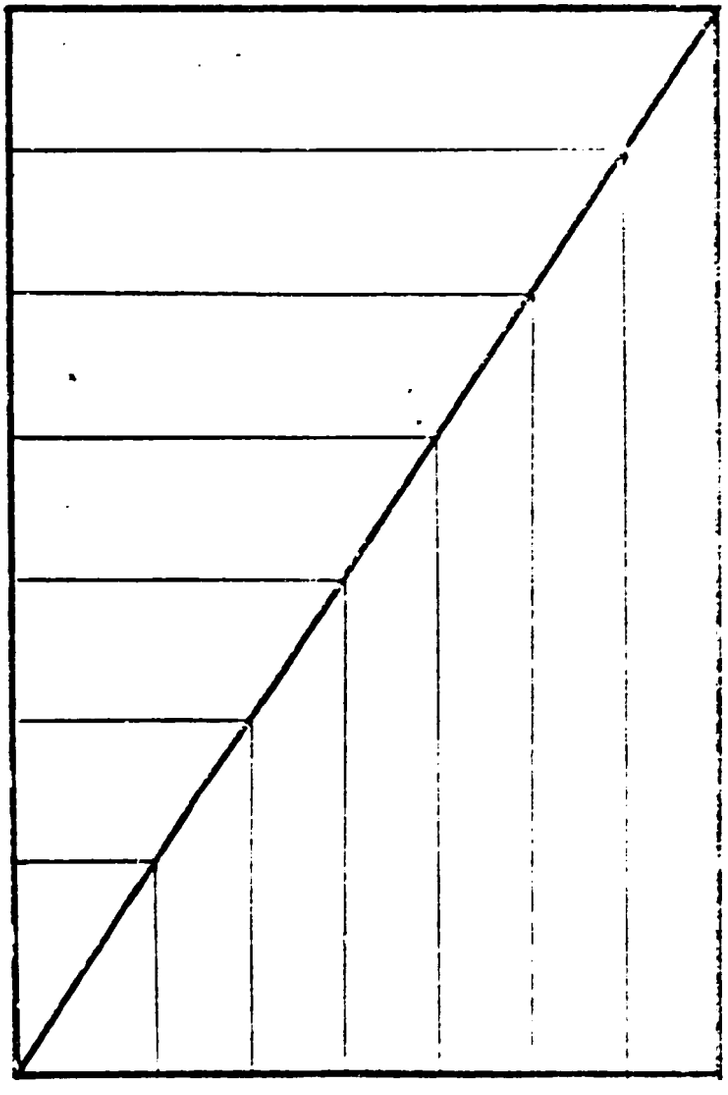


Finished Pouch Length (L)

L= Cutoff length of pouch

W= Slit width of web

Finished Pouch Width (W) A/R=1.500:1.000



Finished Pouch Length (L)

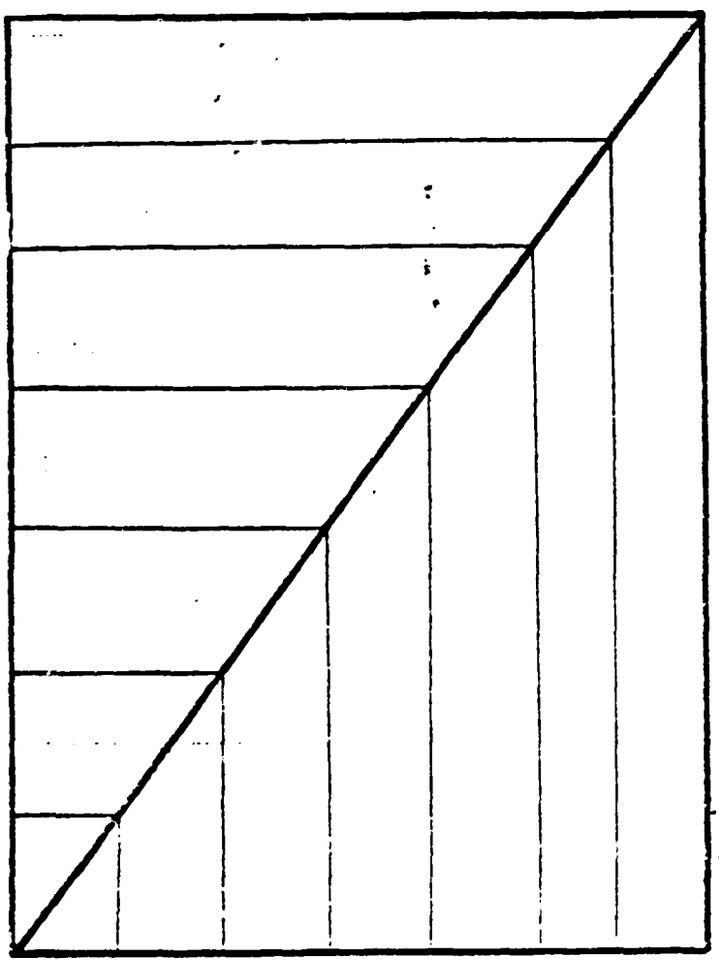
L = Cutoff length of pouch

W = Slit width of web

Not to scale

Finished Pouch Width (W)

A/R=1.333:1.000



Finished Pouch Length (L)

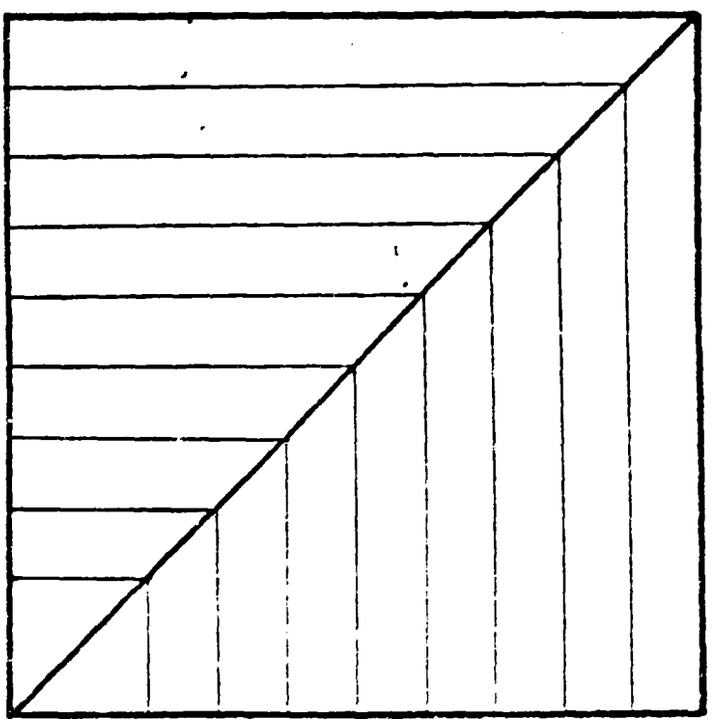
L= Cutoff length

W= Slit width of web

* Not to scale

Finished Pouch Width (W)

A/R=1.000:1.000



Finished Pouch Length (L)

L= Cutoff length of pouch

W= Slit width of web

Not to scale

A/R=3.14:1.000