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TECHNO-ECONOMIC PROFILE

ON

CARBONLESS PAPER

JULY 1991

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TECHNO-ECONOMIC INVESTMENT PROFILE

ON

CARBONLESS COPY PAPERS

1.0 EXECUTIVE SUMMARY

The market for carbonless copy paper for business forms, computer listings and multi-part sets has expanded quickly in recent years. The major manufacturers have invested many hundreds of millions of dollars in large paper machines with on-line coaters to meet that demand. There is now large excess capacity in Europe and the market is highly competitive.

Papermaking requires large volumes of fresh water which would not be available in the Gulf, but paper could be imported in large reels and the special coatings applied. A coating plant is considered which would produce 15,000 tonnes per year of carbonless copy paper representing an annual turnover of US\$ 32.6 million.

The projected return would be US\$ 574,000 per annum.

The investment in machines, equipment, installation, commissioning and training is estimated at US\$ 15,074,000 plus local costs of a 2.25 hectare site, an 8,600 square metre air-conditioned building.

A licence agreement and knowhow agreement will also be necessary. The fee for these agreements is estimated to be in the region of US\$ 1 million.

2.0 PRODUCT DEFINITION

2.1 Product range

Carbonless copy papers are speciality coated papers used to produce impact printed copies. The main uses are in continuous forms and listings for computer print-outs and in multi-part sets for business forms such as delivery notes, invoices and credit card slips. Some of the sheets in multi-part sets are often tinted a different colour to assist in defining the destination of that copy.

There are two main classifications of carbonless copy paper:

2.1.1 Capsulated systems

This system requires the mating of two coatings, one for each surface. The top sheet is coated on the back with an encapsulated solution of colour former. The second sheet is coated on the front with a colour developer. Pressure application, such as writing on a credit slip, ruptures the capsules which activate a chemical reaction with the developer to produce a dyed colour. (Fig. 1)

For multi-part sets the intermediate sheets need to be coated both sides with the capsules on the back and the colour developer on the front. (Fig. 2)

2.1.2 Self-contained systems

The self-contained system has both coatings on one side and therefore allows a plain paper to be used as the top sheet. (Fig. 3)

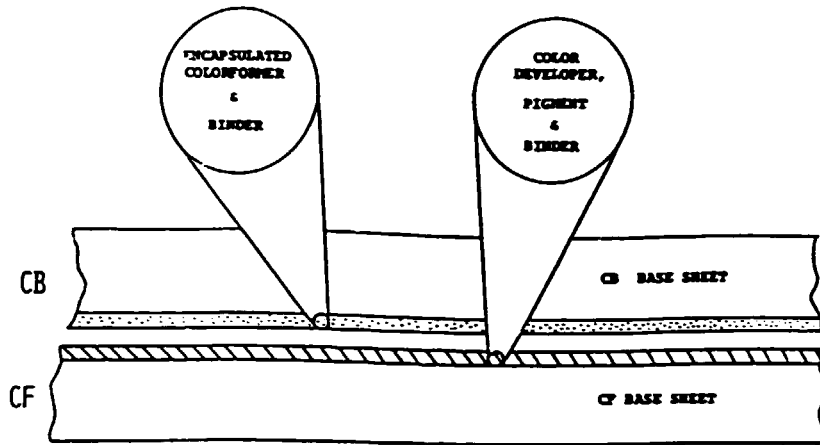


Fig.1 - Two mated chemical transfer capsular carbonless sheets

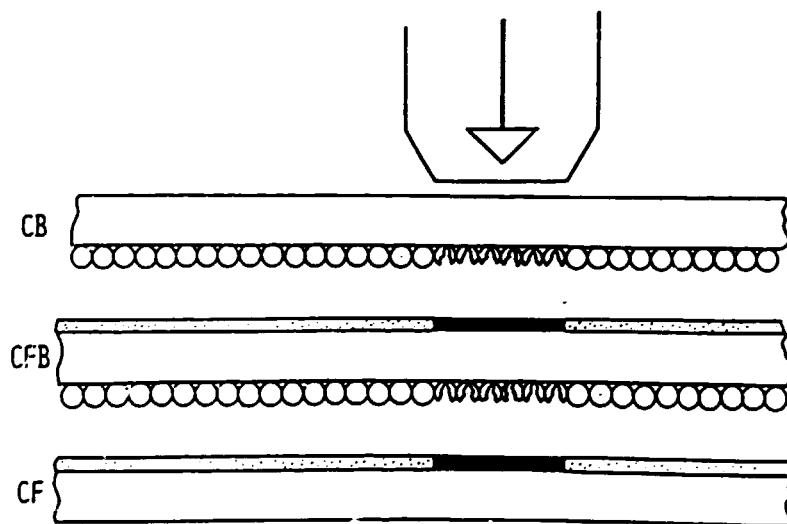


Fig.2 - Three-part capsular carbonless copy form

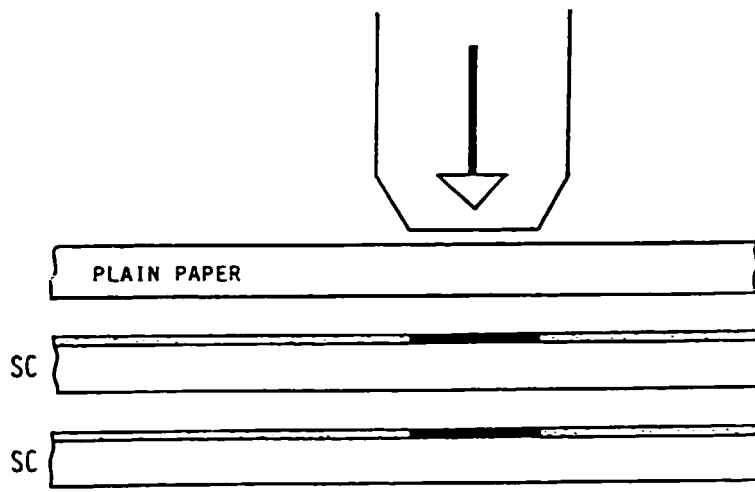


Fig.3 - Three-part self-contained carbonless copy form

The capsulated system is the standard system adopted by nearly all manufacturers although many companies also make the self-contained papers.

2.2 Specifications

There are no standard specifications for carbonless copy paper and each manufacturer produces his own specification. The customers are printers who require the paper to be suitable for their own conversion system into business forms and continuous forms for computer print-outs.

For multi-part sets the paper needs to be thin so that the pressure of the pen or print character can break the capsules through several layers of paper. The weight per unit area or grammage of the coated paper is always specified and is usually in the range 52 to 57 g/m² although for some multi-part sets the back sheet is a thin card.

Some companies use a top sheet which is heavier and can be printed with the company logo in four colours. At the other end of the market, computer listing papers for internal circulation are often made from 100% recycled paper.

In all cases the coatings have to be of consistent quality, uniformly applied and the coating process must be very closely controlled in order to obtain good copy transfer.

3.0 TECHNOLOGY REVIEW

3.1 Review of the options

3.1.1 Paper supply

Most of the larger manufacturers of carbonless copy paper make their own base paper and apply at least one of the coatings on-line on the paper machine. Some apply both coatings on-line and some apply the second coating off-line on a separate coating machine.

Paper manufacture is not only capital intensive but also requires large volumes of fresh water. A mill built on a green field site in Germany in 1988 had a paper machine with on-line coater to produce 80,000 tpy of carbonless copy paper. (About 12 tph). The total project investment was DM250 million and even with the tightest control on water recirculation the plant needed 12 cubic metres of water per tonne of paper. (About 150 m³ per hour).

It is unlikely that large volumes of fresh water for papermaking would be available in the Gulf area and the recommended option is to import the base paper in jumbo reels.

3.1.2 Coating process

There are several different types of coating to produce a carbonless copy paper. These involve chemical reaction or mechanical transfer of the image. Within chemical reaction types there are capsulation and non-capsulation systems. The capsulation system is the one most accepted in the market place and has more applications for business forms.

3.2 A review of production scale ranges

Most off-line coaters for producing carbonless copy paper are designed to coat paper reels between 2100 and 2200 mm wide. The finished reel is slit into widths to suit the customers' process, usually between 215 and 500 mm wide for reels. About 30% to 40% of the coated paper is likely to be required in sheets. The standard sheet sizes include:-

430 x 610 mm, 450 x 640 mm, 610 x 860 mm and 700 x 1000 mm.

Coating operations should be continuous in order to be efficient and to avoid quality variations caused by stop/start fluctuations. This entails 24 hours per day, 7 days per week for 50 weeks per year. Shuts for grade changes and maintenance should be kept to a minimum to allow a net running time of 320 days per year.

In Europe typical off-machine coaters are 2.1 m wide and run at 400 to 800 metres per minute producing 15,000 to 30,000 tpy. On a 52 g/m² coated sheet at 2.1 metres wide and 400 mpm the output will be 63 t/day gross, 53.5 t/day net or 17,000 tpy in a 320 day year.

In the UK 71% of all business forms are printed on carbonless copy paper. With a total population of 411 million in Europe the consumption of carbonless copy paper per capita is 1.23 kg per year. At that rate 15,000 tpy would supply a population of 12 million.

Assuming that in the Gulf market the consumption per capita is comparable with European levels, if the new product could capture 10% of the total market, an output of 15,000 tpy would supply a population of 120 million. In view of the fierce competition for export markets by established producers of carbonless copy paper it is unlikely that a new player in the Gulf will capture more than 10% of the market.

For these reasons it is recommended that a plant capacity of 15,000 tpy would be optimum. Since continuous forms printed from reels are mainly two-part forms and sheets are mainly used for three part sets, the breakdown of products is likely to be:

	<u>Reels</u>	<u>Sheets</u>
Top sheet (CB)	4,500 tpy	1,600 tpy
Bottom sheet (CF)	4,500 tpy	1,800 tpy
Middle sheet (CFB)	1,000 tpy	1,600 tpy

3.3 Recommended production technology

The system with encapsulated solutions of colour former as the coated back and a colour developer as the coated front is recommended. The top sheet has a coated back (CB), the bottom sheet has a coated front (CF) and intermediate sheets are coated both front and back (CFB).

There are several chemical and encapsulation technologies, almost all covered by patents, and some available under licence. Some patent holders are not willing to grant a licence since they manufacture their own carbonless copy paper and export it to the Gulf.

There are several types of coating machine which are suitable. The reel of base paper is unwound, coated on one side, dried and re-reeled to apply the CF coating or the CB coating. For CFB coating a second pass is necessary. Many machinery makers are willing to supply machines for coating, slitting, rewinding, sheeting and packing.

3.4 Sources of Technology

For chemical coating formulations:

Wiggins Teape Ltd., P.O.Box 88, Gateway House, Basing View,
Basingstoke, Hampshire, RG21 2EE, UK.

Tel: 0256 842020 Telex: 858031 WTBSTK G

Fax: 0256 840068

Fuji Photo Film Co., Ltd., 26-30, Nishiazabu 2-Chome,
Minatoku, Tokyo 106, Japan.

Tel: Tokyo 3406-2659 Telex: J24759 (FUJITEC)

Fax: Tokyo 3406-2275, 3406-2777

Cellier SA, Rue du Maroc, B.P.603, F-73106 Aix-les-Bains,
France.

Tel: 79 35 05 65 Telex: 980053 (INOXEL F)

Fax: 79 88 37 71

For coating machines:-

T.H.Dixon & Co. Ltd., Works Road, Letchworth,
Herts. SG6 1LS, UK.

Tel: 0462 685101 Telex: 82212 (DIXON G)

Fax: 0462 670438

Valmet Paper Machinery Inc., Punanotkonkatu 2,
SF-00130, Helsinki 13, Finland.

Tel: 358 0 132971 Telex: 122613 (VALPM SF)

Fax: 358 0 655502

Beloit Walmsley Ltd., Crompton Way, Bolton,
Lancs. BL1 8UL, UK.

Tel: 0204 396060 Telex: 635077 Fax: 0204 20832

Black Clawson International Ltd., Westgate Works, East Dock
Road, Newport, Gwent, NP1 2TT, UK.

Tel: 0633 244441 Telex: 498335 (BCINPT G)

Fax: 0633 212164

4.0 THE PRODUCTION PROCESS

4.1 Description and flow sheet of the recommended technology (Fig.4)

4.1.1 CB coating formulations

Microcapsules provide a physical barrier between the colour former and the coreactant. The minute size of the microcapsules, 4 - 8 microns, may be illustrated by the fact that the striking of a standard typewriter key causes the rupture of 10-15,000 capsules.

The coating mixture contains 60% to 70% microcapsules dispersed in a binder with a pigment to separate the microcapsules. The most common pigments are titanium dioxide and calcium carbonate. Binders include Vinyl acetate latex, Acrylic latex, Styrene butadiene latex, Polyvinyl alcohol, Ethyl cellulose and Carboxymethyl cellulose. Water is the mixing agent.

Coat weights of CB coatings are usually 4 to 5 g/m².

4.1.2 CP coating formulations

Two basic types of coreactant are used:

Inorganic such as acid activated bentonite clays.

Organic such as phenol formaldehyde resins or substituted zinc salicylate.

Activated clays are difficult to coat and require high coat weights of 6 to 8 g/m². Resin coreactants give good image density at coat weights down to 2 g/m² but tend to yellow with ageing. Zinc salicylate gives good black prints at low coat weights in the range 3 to 5

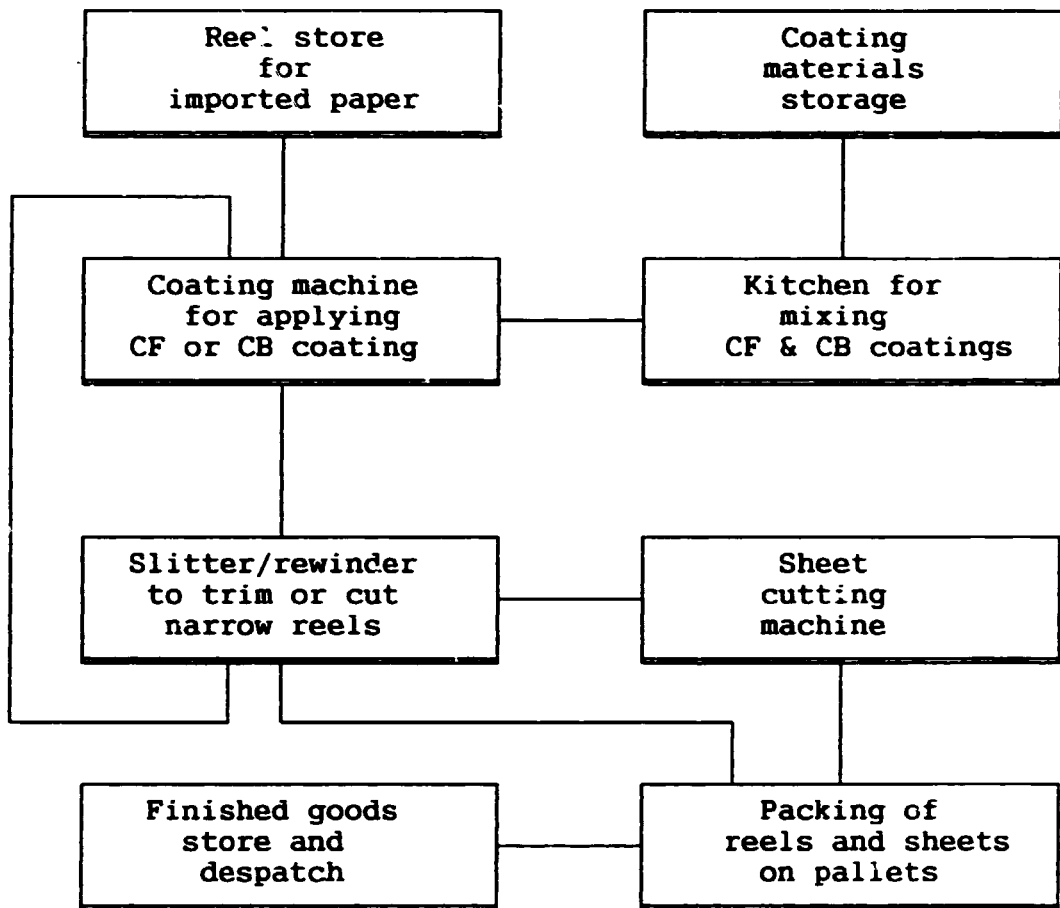


Fig. 4 - Flow Sheet
Carbonless Copy Paper Coating

g/m² and is the preferred coreactant in most CF coatings. It does not yellow and has a good shelf life. Water based coatings are recommended.

Inorganic pigments are used as extenders in CF coatings and include calcium carbonate, china clay, zinc oxide and titanium dioxide. The binders used for CF coatings are the same ones used for CB coatings.

4.1.3 Coating preparation

The CF and CB coatings must be mixed in a coating kitchen in two separate lines under closely regulated control. Mixing is usually in batches with automatic computer control of quantities, mixing sequence and mixing times.

This part of the process is extremely critical since it is important to achieve the correct rheology of the mixture for good control of the coating application.

4.1.4 Coating machine

The machine can run reels of base paper 2100 mm wide at speeds up to 600 metres per minute. The CF coating station applies 3 to 5 g/m² of colour developer to the front of the sheet and dries the coating in an oil-fired hot air dryer about 15m long. (Fig.6)

To control curl a moisturising station applies water to the back of the sheet and dries it on steam heated cylinders. The reel is then rewound.

The CB coating is applied in a similar manner, but using a different coating head for the capsular mixture. For the CFB sheet the CF coated sheet is passed through the coater a second time to apply the

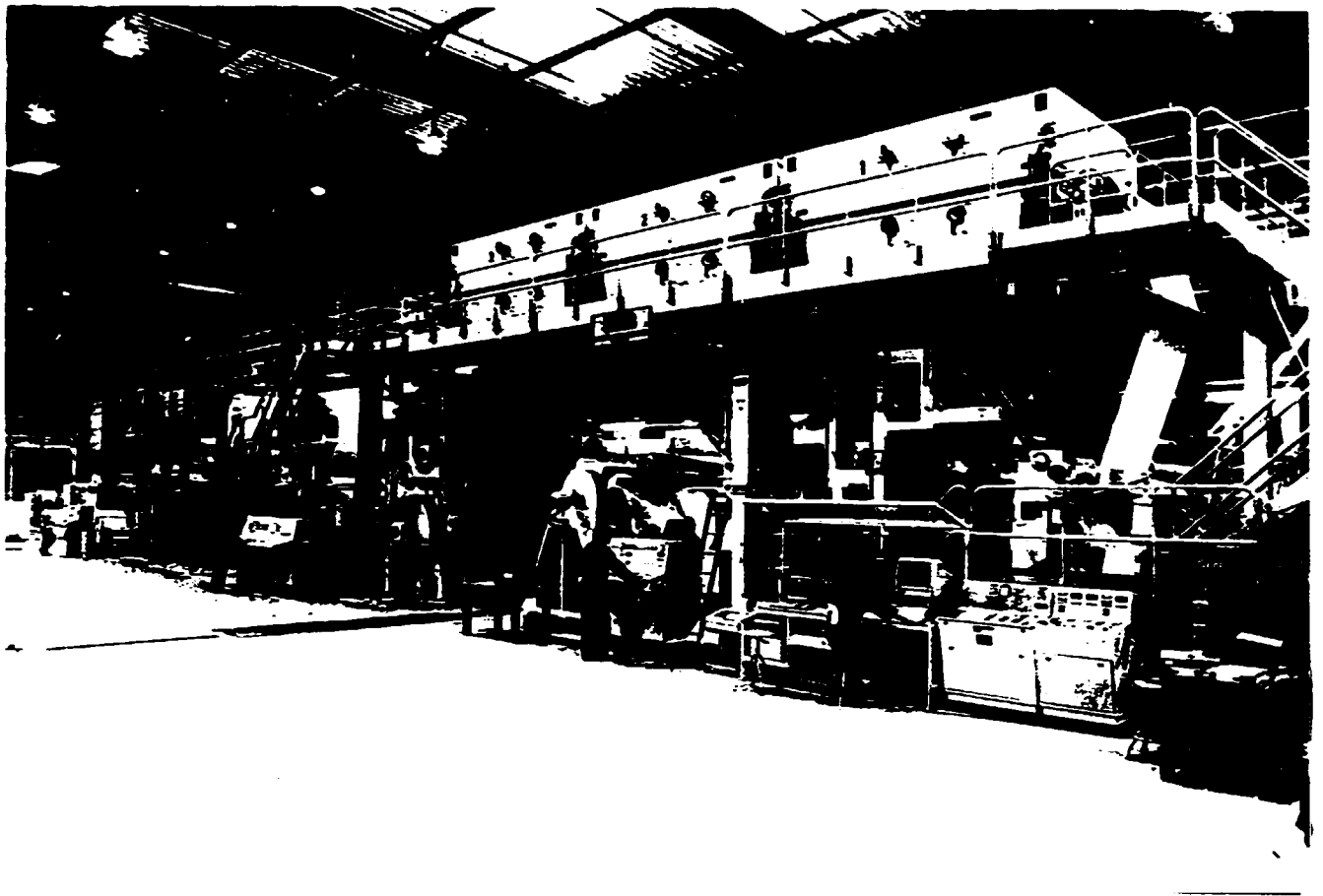


Fig.6 - New coating machine for applying CB coating

(The CF coating is applied on the paper machine)

CB coating.

Successful image transfer on carbonless copy paper is very sensitive to variations in coat weight as well as coating formulation. On-line computer control of coat weight and moisture content in machine direction and cross direction is necessary.

4.1.5. Slitter/rewinder

This machine runs the coated paper through slitters to trim the edges and to cut the narrow reels required by the customer. The slit webs are rewound into reels either to be supplied direct to the customer or to be cut into sheets.

4.1.6. Sheeting machine

Up to four reels can be mounted in the unwind stands and slit to width and cut to length of sheets required by the customer. The cut sheets are stacked on pallets ready for packing.

4.1.7 Packing

Carbonless copy paper needs careful handling to avoid breaking the capsules of the coated back. Reels for conversion into continuous forms are mounted on pallets with discs of board to protect the ends and a fixing through the reel core. The reel and pallet is stretch wrapped with plastic film as a barrier against moisture. Some manufacturers use a layer of protective foam packing before stretch wrapping.

Sheets are normally carton packed in 500's, stacked on pallets, protected with a board at the top and strapped securely to the pallet.

4.2 Outline list of machinery and equipment

	<u>000's US\$</u>
Coating machine	7,310
Steam boiler for drying	80
Coating kitchen equipment	2,550
Slitter/rewinder	730
Sheeting machine	306
Stretch wrapping machine	31
Clamp lift truck for reels (x2)	85
Floor sweeping machine	25
Fork lift for pallets and chemicals	34
Pedestrian pallet trucks (x2)	21
Engineers workshop machines	255
Quality control laboratory instruments	75
Machine house travelling crane	60
Racking/shelves	25
Air compressor	35
Baling press for trim and reject paper	25
Total of machinery and equipment	11,647
Initial set of spares	873
(estimated at 7.5% of the capital cost of the machinery)	

Paper is very sensitive to changes in relative humidity in the air and it is advisable to air condition storage and process buildings. This is important in the coater machine house where the hot air drying oven and the drying cylinders will drive up the temperature and make operating conditions very uncomfortable. The air conditioning equipment has not been included in the list of machinery above since it is regarded as part of the building design and cost.

4.3 Budget cost estimate for machinery and equipment

The total of the above list of budget prices ex-factory is US\$ 11.65 million. Carriage, insurance and freight will add about 10% or US\$ 1.165 million, making a total of US\$ 12.815 million.

4.4 Budget cost estimate for erection of machinery

The capital cost of the major items of machinery that require installation amounts to US\$ 11.267 million. Installation cost is estimated at 10% of the capital cost or US\$ 1.127 million. Local subsistence costs are not included in this estimate.

4.5 Estimated size of required site

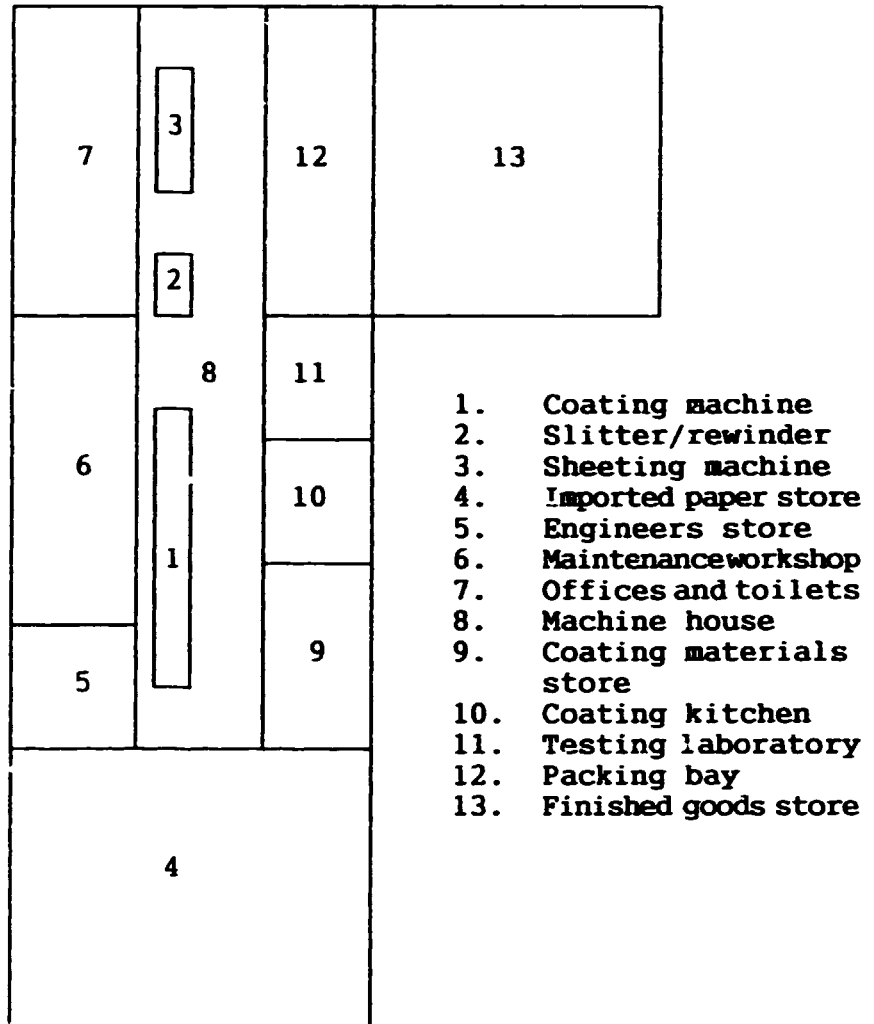
A plan for a suggested building layout is shown in Fig. 5. With allowance for on-site roads, banded oil storage, loading and unloading areas, hard standing and car parks for staff and operatives, the site should be 150 metres by 150 metres or 2.25 hectares.

4.6 Details of buildings

Referring to the main parts of the plan in Fig.5:

4 - The store for imported paper is 2000 m² to hold 6 weeks' supply of reels stored on end, two high. A smooth floor, regularly swept by machine, is important to avoid damage to reel ends.

8 - The coating machine is 40 metres long and to keep the rewinder and sheeting machine in line under the crane the machine house needs to be 100 m long by 18m wide.



Approximate scale 1000:1 (1mm = 1 metre)

Area approximately 8,600 m²

Fig. 5 - Building Plan
Carbonless Copy Paper Coating

5/6 - Maintenance is important to keep lost time to a minimum and the workshop needs lathes, milling machines and other equipment. Storage for spares and materials will also need racking. The area 60m x 18m can be subdivided to suit.

9 - Storage of coating materials needs good facilities and organisation to avoid losses or contamination of these expensive items. Depending on the technology employed, some of the chemicals could be slightly hazardous to health and suitable precautions will be needed. Area 25m x 15m.

10 - The coating kitchen needs to be clean with tiled floors and adequate drains for washing down any spillages. Area 18m x 15m.

11 - The laboratory will test incoming paper quality, coating formulations and finished coated paper. It will need close control of temperature and relative humidity. Area 17m x 15m.

12 - The packing bay will house the stretch wrap machine and will need storage for packing materials and pallets. Area 40m x 15m.

13 - Reels and sheets on pallets will need to be stored on racks with access aisles for fork lift trucks. A despatch area with large doors and vehicle loading bay will be needed. Total area 40m x 40m.

7 - The office block could occupy two floors with production and maintenance staff on the ground floor and administration and accounts staff above. The ground floor area is 40m x 18m.

The internal height of the building in area 4 is 5m to allow end-on stacking two-high of reels 2.1m wide. A similar height in the finished goods area will allow for storage

racks. Both these areas will require sprinkler systems and smoke alarms.

The coater is likely to be 6m high and to allow for a travelling crane above it, the main machine house should be 8.5m high internally.

The need for air conditioning requires that all the buildings have good insulation. Good levels of lighting are also important.

The coater, rewinder and sheeting machine are not very heavy but require solid foundations to ensure accurate alignment of the various sections of the machines.

4.7 Pre-production costs

The coating formulation and knowhow will almost certainly need to be licenced. This could be a lump sum in the region of US\$ 1 million. An alternative is to negotiate a down payment plus a royalty on the coating chemicals if they are purchased from the licensor or on the sales of coated paper.

Commissioning and training on the coater will cost US\$850,000.

Installation and commissioning of the rewinder is included in the price. Training will be US\$ 3,000.

Installation and commissioning of the sheeting machine is included in the price. The cost of training is estimated to be US\$ 2,000.

Commissioning and training for the stretch wrapper is US\$ 3,000.

Installation of workshop lathes, mills and other machines is estimated at US\$ 6,000.

A summary of the above pre-production costs excluding any knowhow agreement or royalty:

Coater	US\$ 850,000
Rewinder	US\$ 3,000
Sheeting machine	US\$ 2,000
Stretch wrapper	US\$ 3,000
Workshop machinery	US\$ <u>6,000</u>
Total	US\$ <u>864,000</u>

4.8 Raw materials and consumable items required

4.8.1 Base paper for carbonless copy coating in reels 2100 mm wide and quantities up to 15,000 tpy. The specification of the base paper is critical and recommended paper properties are listed in Table 1. The quality of the base paper is the greatest determining factor in the successful development of carbonless copy paper.

4.8.2 Coating chemicals for CB coatings. The exact nature of the chemicals will depend on the particular technology used, but will consist of 598 tpy of microcapsules of colour former, 139 tpy of pigment to separate the microcapsules and 184 tpy of binder to provide a good binding function, film flexibility and stability to changes in humidity.

4.8.3 Coating chemicals for CF coatings, which will consist of 516 tpy of coreactant which will be extended with 111 tpy of pigment to give the rheological requirements of the coater. The 111 tpy of binder is similar to the CB coating mix.

Table 1 - Specification of base paper for
carbonless copy paper

		CB or CF	CFB
Grammage	g/m ²	50	40
Thickness	micron	50-60	45-50
Extraction pH		5.5-7.7	5.5-7.7
Ash	%	8-12	7-10
Smoothness (Bendtsen)	ml/min	150-200	120-150
Porosity (Schopper)	ml/min	50-70	40-60
Brightness (Minimum)	ISO	75	75
Moisture	%	4.5-5.5	4.5-5.5

For good uniform coating it is important that the formation or look-through of the paper is not blotchy or full of flocks. A smooth, even formation provides a good foundation for the coating process.

4.8.4 Reel cores for customer reels. The length of core per tonne of paper will depend on the reel diameters required by the customers. Allowing 2 metres of core per tonne of coated paper, 20,000m of cores will be needed.

4.8.5 Packing materials for sheets on pallets which will include cartons, the pallets, protective boards, plastic strapping and stretch wrap plastic film.

Packing materials for reels on pallets will need the pallets, a wooden pole through the cores to locate the reels on the pallets, discs of board to protect the reel ends and stretch wrap plastic film.

Approximately 5,000 tpy of sheets in 8kg cartons will require 625,000 cartons. If the pallets are non-returnable about 30,000 will be needed per year. Each pallet will require about 1 kg of stretch wrap film, or 30 tpy. Protective boards will probably also be non-returnable and require nearly 1.2m² per pallet or 36,000m² per year. Plastic strapping at 7m per pallet could total 210km per year.

4.9 Raw material and consumables prices

	US\$
4.9.1 Carbonless copy base paper	
per tonne of 45 g/m ²	1066
per tonne of 48 g/m ²	1040
4.9.2 Capsules for CB coating (per T)	15000
4.9.3 Pigments for CB coating (per T)	300
4.9.4 Coreactant for CF coating (per T)	5000
4.9.5 Pigments for CF coating (per T)	300
4.9.6 Binders for CB & CF coatings (/T)	2000

4.9.7	Reel cores per km	1000
4.9.8	Cartons for sheets (per 1,000)	150
4.9.9	Wooden pallets (US\$ per 100)	650
4.9.10	Protective boards (per 100m ²)	150
4.9.11	Stretch wrap film (US\$ per 100kg)	300
4.9.12	Plastic strapping (US\$ per km)	28

4.10 Utility requirements

- 4.10.1 Electric power for the drives on the coater, rewinder and sheeting machine should amount to 150 kWh. Electricity for lighting and air conditioning is considered to be part of the running costs of the building, not of the process.
- 4.10.2 5m³ of water per day will be required for mixing the coatings. For the building the normal washing and toilet facilities will require water.
- 4.10.3 Oil for hot air drying of the CF or CB coatings and steam for the drying cylinders will require 900 kg per day. The type of oil required is diesel burning oil with a calorific value of 45.7 MJ/Kg

4.11 Normal annual maintenance

Since initial spares at 7.5% of the cost of the capital equipment has been allowed within the capital cost, maintenance spares in the first two years should be only 1% of capital equipment cost or US\$ 116,000 each year. This could increase to US\$250,000 in the third and subsequent years.

4.12 Manpower requirements

4.12.1 Shift workers

A continuous operation requires 5 shifts to allow for holidays and sickness. The number of shift workers is anticipated to be:

	No./shift	Total
Shift foreman (Supervisor)	1	5
Coater operator (Skilled Worker)	4	20
Rewinder operator (Skilled Worker)	2	10
Sheeter operator (Skilled Worker)	2	10
Coating kitchen attendant (Skilled Worker)	1	5
Laboratory technician	1	5
Reel store driver	1	5
Packers (Semi-skilled Workers)	<u>3</u>	<u>15</u>
Totals	<u>15</u>	<u>75</u>

4.12.2 Day workers

General manager	1
Day superintendent (Engineer)	1
Despatch loaders (Unskilled Workers)	2
Despatch clerk (Clerk)	1
Maintenance foreman (Engineer)	1
Fitters (Skilled Workers)	2
Sales manager (Department Head)	1
Technical sales/customer service (Technician)	1
Accountant/administrator	1
Accounts clerk (Clerk)	<u>2</u>
Total	<u>13</u>

4.12.3 Skill levels

The General Manager should have at least 5 years experience of management in a continuous production environment. Preferably knowledgeable in the paper and printing industries. Formal qualifications may be in science or accountancy.

The Accountant/administrator needs to be a qualified accountant.

The Sales Manager needs experience in the printing industry to be able to talk to customers in their own language. He also needs five years sales experience.

The Day Superintendent should have five years experience in coating paper and two years in man management.

The Shift Foreman needs three years practical experience in coating paper.

The Technical Sales/Customer Service representative needs A-level chemistry and two years experience in printing.

The Laboratory Technician should have A-level chemistry and experience in paper testing.

The Maintenance Foreman should be fully apprenticed in mechanical engineering with five years experience in maintenance in a continuous process industry.

Fitters should be skilled tradesmen, preferably one mechanical and one electrical.

The Despatch Clerk needs to be numerate and capable of stock taking and keeping stock records on computer and

typing despatch notes.

The operators on the coater, rewinder and sheeter should have some experience in papermaking.

The remainder are operators who need general factory skills.

4.13 Initial production levels

A typical learning curve takes 3 years to achieve full production starting with about 65% in the first year. Annual production achievable should be:

Year 1	9,750 tonnes
Year 2	12,000 tonnes
Year 3	14,000 tonnes
Year 4	15,000 tonnes

4.14 Estimate of required construction period

Building	30 weeks
Coater construction	52 weeks
Shipping	6 weeks
Installation	10 weeks
Commissioning	4 weeks

All other machines will take less time than the coater and the building will be built before the coater is delivered. The total time from signing the contract to starting production is estimated at 72 weeks.

4.15 Environmental aspects

The waste products are rejected paper and trimmed paper which will be baled. The quantity is estimated at 2250 tpy. There is a market for this in some paper mills, for example those in Egypt.

Apart from normal office waste water, there will be a chemical effluent from washing down the coating kitchen tanks and any floor spillages. The nature of the chemicals will depend on the technology licenced but should be acceptable in the municipal sewer.

5.0 PRODUCTION COSTS

These are estimated for the three different papers and the different coatings they receive. The small differences in grammage have been ignored. The costs are expressed in US\$ per tonne of coated paper.

	<u>CB</u>	<u>CFB</u>	<u>CF</u>
<u>Reels</u>	<u>4500 tpy</u>	<u>1000 tpy</u>	<u>4500 tpy</u>
Materials	2080	2357	1391
Labour	79	79	79
Overheads	95	95	95
<u>Sheets</u>	<u>1600 tpy</u>	<u>1600 tpy</u>	<u>1800 tpy</u>
Materials	2400	2720	1616
Labour	147	147	147
Overheads	95	95	95

Labour costs are for production and maintenance staff and operatives.

6.0 INTERNATIONAL PRICES

List prices for 1 tonne quantities ex-merchant warehouses in US\$ per tonne for white carbonless copy paper:

	<u>CB56</u>	<u>CFB53</u>	<u>CF57</u>
Reels	2210	2550	1870
Sheets	3400	4250	2890

There is a small upcharge of about 3% for colour tinted papers.

In the present over-capacity situation in Europe these prices are heavily discounted. There are also quantity discounts. Allowing for these discounts and the margins for the merchant, the prices in US\$ per tonne achieved by the manufacturer are estimated to be:

	<u>CB56</u>	<u>CFB53</u>	<u>CF57</u>
Reels	1880	2170	1590
Sheets	2890	3610	2455