The Journal of the Institute of Hospital Engineering August 1982

HOSPITAL ENGINEERING

Annual Conference 1982
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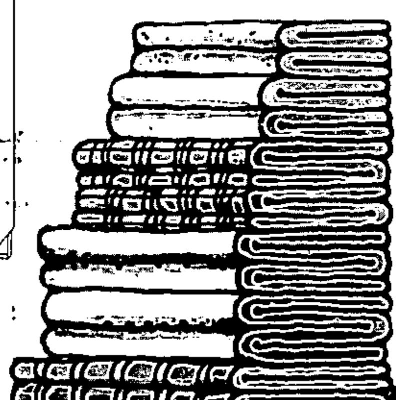

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HOSPITAL ENGINEERING

The Journal of the Institute of Hospital Engineering

Contents

Volume 36 No. 6 **August 1982**

Front Cover:
The President of the Institute speaks at the Guest Night Dinner at the Institute's Annual Conference at Stratford-upon-Avon in May. See our report on page 4.

Institute News

Birthday Honour for Past President

As stated briefly in last month's *Newsletter*, Lawrence Turner, chairman of Static Systems Group, Wombourne, Wolverhampton, has been appointed OBE in the Birthday Honours list, for services to hospital engineering.

The award reflects the increasing importance of hospital engineering, now accounting for more than 40 per cent of the costs of modern hospitals, clinics and other buildings which place great emphasis on safety, communications and maintenance.

Lawrence Turner, 53, was President of the Institute of Hospital Engineering, 1979–81, and was responsible for encouraging important developments in standards. quality and techniques, and for improving all aspects of engineering within the British health service and private medicine. He is also one of the two British members on the Council of the International Federation of Hospital Engineering, which had its bi-annual congress recently in Amsterdam.

As founder and chairman of what is now Static Systems Group, he was responsible for pioneering the Statiscan TDM (time division miltiplexing) method of monitoring and controlling fire, security and plant; for developing electronic nurse call systems and many other electronic-based communications systems.

Lawrence Turner also serves on the management and design committee of the Institution of Electrical Engineers.

In 1973 he was a founder member of the Engineering Group Training Scheme at Aston University (where he read Electrical Engineering) which aims to provide students with industrial training for their sandwich degree course.

He and his wife Jeanette enjoy music and play the piano, and his children (Adrian, 24 an engineer at Static Systems Group; Christopher, 23, a pharmacist; and Susan, 16, who is at school in Cheltenham) also play various instruments. He is also a keen sailor.

He lives at Harborough Hall, Blakedown, Kidderminster.

Appointment of Branch Officers

London Branch

The Branch Officers for the London Branch, 1982/83 are:
Chairman: D. L. Davies Esq.
Treasurer: W. P. Lawrence Esq.
Secretary: P. C. Vedast Esq. 59 Oakfield Gardens, Edmonton, London N18 1NY.

Former Member ordained

John Hall, who spent twelve and a half years as an engineer in the Health Service was ordained on the 27th June. His Health Service career started in March 1968 when he became Assistant Engineer at Exe Vale Hospital. In April 1970 he moved to St Mary Abbots Hospital in London as Hospital Engineer, a post which he held until September 1972 when he became Deputy Group Engineer at Northampton and Distric HMC. In July 1975 he took up his last appointment in the Health Service as District

Appointment of District Works Officers

Wessex RHA

Southampton DHA *R J Bickle* BSc MCIBS
West Dorset DHA *L R F House* CEng MIMechE MIHospE MBIM
Salisbury DHA *D Wilson* TEng(CEI) MIHospE LICI PlantE
Winchester DHA *DJ Wicks* TEng(CEI) FIHospE
Swindon DHA *J. Reilly* FIHospE MIPlantE
Basingstoke DHA *F McNeill* (Acting)
Bath DHA *W. J. Clarke* CEng MIEE
Isle of Wight DHA *D W Wastall* BSc CEng MIMechE (Acting)

Northern RHA

Hartlepool DHA Vacant
North Tees DHA *F P Williams* BA CEng MIMechE
South Tees DHA *W Murray* CEng MIMechE FIHospE
East Cumbria DHA *S Henderson* MCIBS FIHospE
South West Cumbria DHA *H Moffatt* CEng MIMechE
West Cumbria DRIA *J Taylor Esq*
Darlington DHA *J Williamson* FIHospE AMIERE
Durham DHA *L Graham* BArch (Dunelm)
North West Durham DHA *P Penfold* CEng RIMarE
South West Durahm DHA *L Finney Esq.*
Northumberland DHA *J Stewart* CEng MIMechE MIMarE MIHospE
Gateshead DHA *M H Smith* CEng MIMechE MBIM FIHospE
Newcastle DHA *R J Matterson* CEng MIMechE
North Tyneside DHA *O Mole* CEng MIMechE FIMarE
South Tyneside DHA *J H Millar* RIBA ARIAS FBIM
Sunderland DHA *L Bytheway* FRICS ACI Arb

Yorkshire RHA

Hull DHA *R C Wilson* CEng MIMechE MBIM FIHospE
Grimsby DHA *R B Brackenridge* MIMechE MIE MCIBS
Scunthorpe DHA *M J McCormick* MIPlantE MIEETE
Northallerton DHA *J C Pulman* Dip BE ARICS MCIOB DMS MBIM
York DHA *G Perry* CEng MIMechE FIHospE Grad. PlantE
Harrogate DHA *A R Johnston* BSc Dip MS MIEE MIMechE MBIM MIMC
Bradford DHA *D G Jenkins* CEng MICE MIMechE MInstE
Airedale DHA *J Clark* CEng MIMechE MIWM
Calderdale DHA *D Milligan* FRICS ARICS BSc (RIBA)
Huddersfield DHA *J G Hardman* CEng MIMechE FIHospE
Dewsbury DHA *C G Chester* MIBM AMCIBS
Leeds Eastern DHA *L Blakey* CEng MIMechE
Wakefield DHA *R Garside* Dipl Arch RIBA
Pontefract DHA *A Hargreaves* MIHospE MIPlantE MIIM MBIM CTechE

Engineer with Kettering Health District.

In September 1980 he resigned to go to the College of the Resurrection at Mirfield in West Yorkshire. Following his ordination he became a full-time stipendiary clergyman as a curate in the Parish of Christ the Carpenter, Peterborough.

We would like to take this opportunity to offer our congratulations, and very best wishes for the future.

Total Energy Stations

A report on the successful joint meeting between the Yorkshire Branch and Leeds Energy Managers Group, 14 June 1982.

This was the second joint meeting in the current programme of the Yorkshire Branch to ensure improved attendance at special events. Attendance expectations were exceeded as both Chairmen, Mr A. E. Horvath and Mr A. Haley, of the respective organisations welcomed the audience to the joint venture and introduced the speaker, Mr Stan Whitehead, Station Superintendant of the Leeds General Infirmary Total Energy Station.

The presentation by Mr Whitehead commenced with an appraisal of the world-wide efficient use of fuels, and the origin of the terms 'Total Energy' and 'CHP' (Combined Heat and Power), both used in the USA. The talk continued with reference to the three basic systems we have today, back pressure turbine systems, reciprocating engines with waste heat recovery and gas turbines with waste heat recovery.

The Total Energy Station at the Leeds General Infirmary was commissioned during 1977 and consists of five reciprocationg engine sets with waste heat recovery. Mr Whitehead continued his talk with specific reference to details of maintenance, fuel costs and electrical generation. Phase 1 of the new Leeds General Infirmary is due for commissioning in 1983 which will have an estimated maximum electrical demand of 8.1 MW, in addition to the existing Hospital and University demands for heat and power.

An excellent slide presentation then followed which was produced by Leeds Polytechnic as a teaching aid to students on total energy stations.

Following a discussion and question period, members were invited to tour the energy stations at the Leeds General Infirmary.

A vote of thanks to Mr Whitehead was given by Mr J. R. Fielding, Institute of Hospital Engineering, on behalf of the two organisations.

Forthcoming Branch Meetings

Southern Branch: *Hon. Sec: R. P. Boyce Chichester (0243) 781411*

11th September, 3 pm	Natural Gas Production & Distribution	Southampton General Hospital.
25th November, 1.30 pm	Visit to Fawley Refinery	

East Anglian Branch: *Hon Sec: M. Brooke Great Yarmouth (0493) 50411*

25th September	Energy Mangement Systems Presentation by Transmitton	Kings Lynn District General Hospital
12th October	Visit to Linby Colliery, Nottingham	

Midlands Branch: *Hon Sec: W. Turnbull Birmingham (021) 378 2211 ext 3590*

28th September	Energy System by Transmitton	East Birmingham Hospital
19th October	"Design Parameters and Application of Air to Air Heat Pumps" E.G.A. Godall Esq. Trace Heat Pumps Ltd.	West Midlands RHA

London Branch: *Hon. Sec: P. C. Vedast London (01) 807 7340*

14th September 6.30 for 7 pm	Computer Aided Design	Wolfson Lecture Theatre The National Hospital
23rd November 6.30 for 7 pm	Optimum Energy Usage	Wolfson Lecture Theatre The National Hospital

North Western Branch: *Hon. Sec. E. A. Hateley Manchester (061) 236 9456 ext 452*

19th October	Visit to the Greater Manchester Fire Service Headquarters. Tour of the new Control Room and talk by the Fire Officer.	

Scottish Branches Conference: *T. M. Sinclair Glasgow (041) 332 9696 3 Morven Way, Kirkintilloch, G66 3QL*

28th, 29th and 30th October	Information Technology Year 1982	Walton Conference Centre Southern General Hospital Glasgow.

Those wishing to attend any of the above meetings please contact the relevant Local Secretary.

Annual Conference 1982

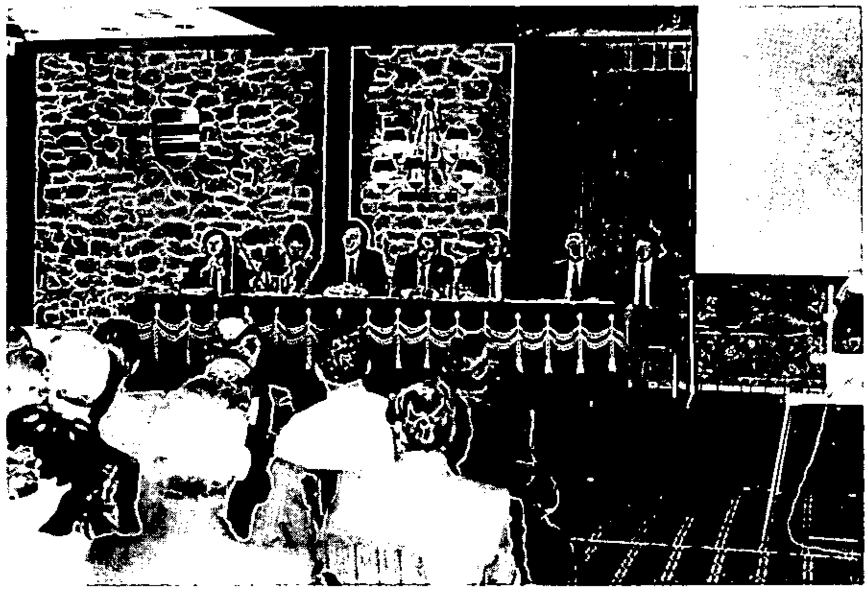
Stratford-upon-Avon — 19-21 May

The 38th Annual Conference of the Institute was held at the Hilton International Hotel, Stratford-upon-Avon — delightful surroundings for an event which as usual combined hard work and good fellowship in the best traditions of the Institute.

The technical papers studied Telecommunications and Computers in the NHS, The Alternative Contract Methods in use in the Service, and A Review of Progress on System Hospital Building. Many of the papers given will appear in *Hospital Engineering* in due course.

On the social front, there was a successful visit to the Royal Shakespeare Company just across the road, and the usual interesting Ladies Programme.

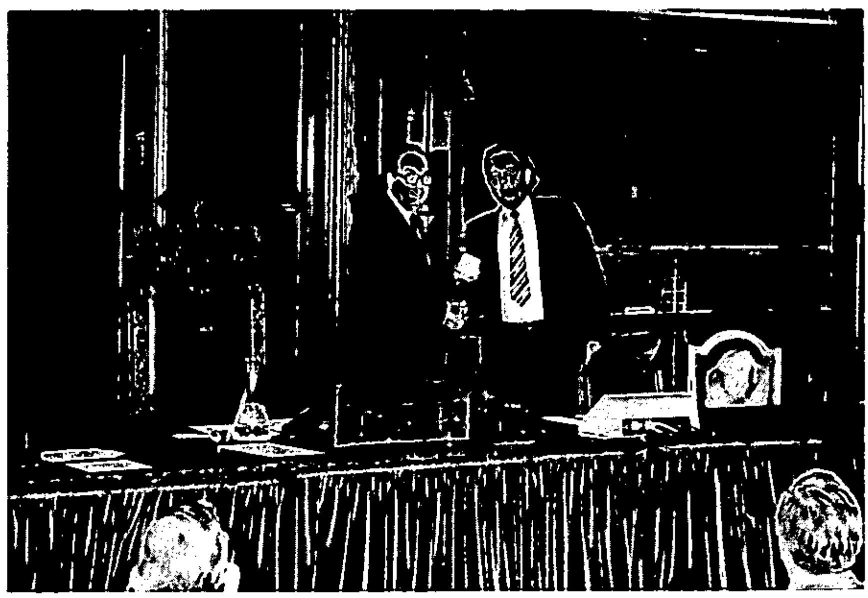
The final evening consisted of an experimental new format for what has always in the past been a dinner-dance. This time there was no dancing, but a fairly lengthy entertainment by the Masons Apron Clog Morris and the Charlbury Dancers — an interesting sidelight on local folk music and dancing, performed by an enthusiastic group of very accomplished amateurs. As the photograph below shows, it included an amusing comedy turn by a young man who spent quite a lot of his time up a ladder.



Above right: *A distinguised group of panelists bring the day on Contracts to a close with a question and answer session.*
Below: *The star turn of the evening, up his ladder.*

Northcroft Silver Medal Presentation

Ken Eatwell, who recently retired from the Council, *(see* **Hospital Engineering Newsletter** *July 1982),* presenting the Northcroft Silver Medal to Mr M. Woodroofe. The presentation was made at the Institute's Symposium on Hospital Linen Services at the Institution of Mechanical Engineers on Wednesday the 16th June. Mr Woodroofe won the award for his paper entitled *'Installation of a Honeywell Delta 1000 Building Services Management System'* which appeared in the October 1981 issue of *Hospital Engineering.*



This article first appeared as a paper at the Institute's Symposium on Hospital Linen Services. The author is Superintending Engineer at the Department of Health and Social Security.

Laundry Energy Conservation

V E SKEGG CEng MIMechE MIMarE MCIBS, MInstR

Introduction

The laundry process is one in which a great deal of energy is used and then totally discharged to atmosphere or to drain. It is inherently and traditionally a total loss process. Two years ago, I presented a paper entitled 'Progress in Laundry Heat Recovery' at the 1980 Annual Conference, and the objective of this paper is to update the information previously provided, and to report on the numerous experiments, field trials and prototype installations which have been carried out during the last 2 years. Reference will also be made to the many commercial developments which have taken place and NHS operational experience will be given where available.

Tumbler driers with inbuilt thermal wheels

My previous paper reported the results of tests on Ortex 75 kg batch tumblers with integral thermal wheels, which had been newly installed in Groby Road Hospital Laundry, Leicester. Subsequently, Passat tumblers with similar heat recovery facilities became available and a further series of trials were conducted by the same independent test house on Passat 50 kg batch machines at St George's Hospital, Tooting. A summary of the results obtained under the 'conditioning' mode of operation are set out in Table 1 for both sets of trials.

The evidence from this set of trials is that the saving in steam consumption arising from the provision of a thermal wheel for heat recovery is of the order of 15%. Since this value is much lower than the 33% sensible heat recovery which is theoretically attainable, investigations were carried out to confirm that moisture transfer was taking place across the wheel. *Graph 1* illustrates that a small transfer was taking place with the wheel 'off' and a very large one with the wheel in operation. The latter is due to the carry over of moisture globules in the wheel matrix. *Graph 2* shows that there is a very considerably transfer of warm (moisture laden) air from the extract side of the wheel to the inlet side when the wheel is in the stationary position. The obvious deduction is that this leakage is occuring at the edge seals due to the pressure difference which exists between the air inlet and exhaust sides of the machine. This is caused by the basic configuration of the various engineering components of a tumbler drier, which infringe the cardinal principle that balanced pressures are necessary if unduly high leakage rates are to be avoided. The machine layout at *Figure 1* illustrates this point.

As a result of this design shortcoming it was recommended in the May 1980 paper that manufacturers should provide plate type heat exchangers in lieu of the thermal wheel. I am glad to report that the equipment manufacturers have belatedly come to the same conclusion as a result of Continental experience and the first trial on an Ortex tumbler with plate exchanger heat recovery is scheduled to take place at the Royal Devon and Exeter Hospital (Wonford branch) shortly.

Table 1: Tumbler Driers with Integral Thermal Wheels

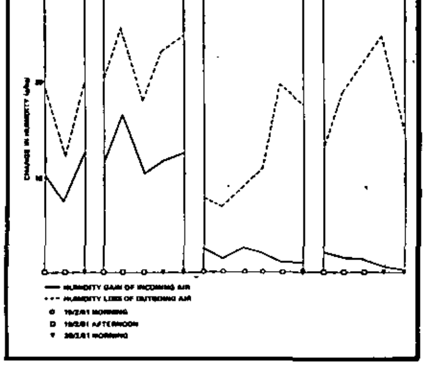
(a) Ortex Batch Tumbler — 75 kg Rating

Load	Steam Flow (Kg/hr) Wheel 'On'	Steam Flow (Kg/hr) Wheel 'Off'	% Saving
Cotton Sheets	215	250	14.0
Draw Sheets	225	270	16.7

(b) Passat Batch Tumbler — 50 kg Rating

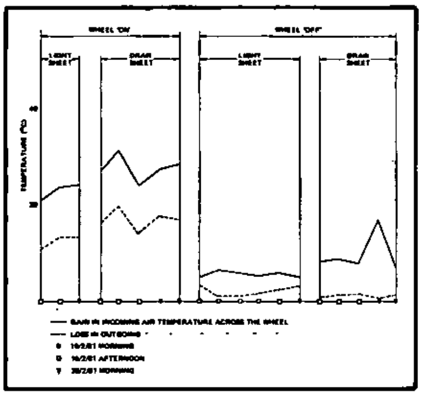
Load	Steam Flow (Kg/hr) Wheel 'On'	Steam Flow (Kg/hr) Wheel 'Off'	% Saving
Cotton Sheets	153	165	7.3
Draw Sheets	150	172	12.8

Graph 1: Thermal Wheels - Humidity crosschecks on inlet and exhaust ducts



Tumbler driers with cross-flow plate type exchangers

The crossflow type plate heat exchanger illustrated at *Figure 2* is particularly suited to the tumbler drier application due to its comparatively low resistance to airflow and its sealed construction. It does however possess a comparatively low sensible heat recovery characteristic — approx 50% compared to the 75/80% theoretical recovery efficiency of a thermal wheel. This type of equipment has become widely available in the form of retrofit kits produced either by the tumbler manufacturer or by specialist engineering firms for most of the common types of tumbler drier installed in NHS laundries. Experience of this type of equipment is summarised below.



Graph 2: Thermal Wheels - Temperature crosschecks on inlet and exhaust ducts

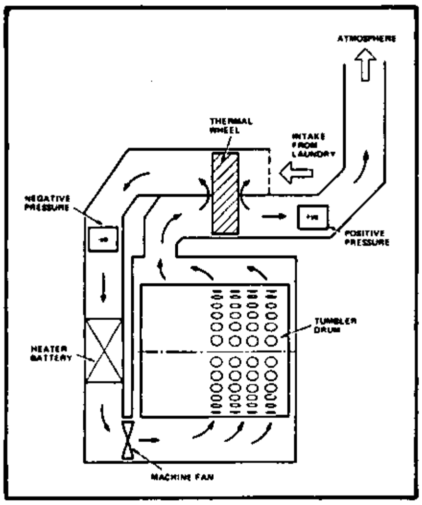


Figure 1: Diagrammatic arrangment of tumbler drier showing unavoidable leakage at edge seals on thermal wheel.

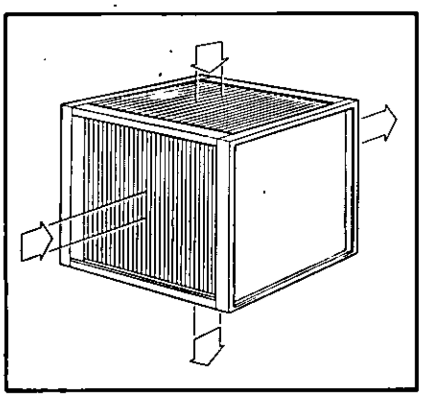


Figure 2: Crossflow heat recovery unit

(a) Bolton General Hospital			
	Test Load—Blankets	—	25 Min cycle time
	Sensible Heat Recovery	—	45% Efficiency
	Saving in Steam	—	33.7%
	Payback	—	Approx 4 Years
(b) Queens Park Hospital—Blackburn			
	Test Loads (Blankets	—	30 Min cycle time
	(Towels	—	25 Min cycle time
	Sensible Heat Recovery	—	46 to 49%
	Saving in Steam	—	34.8% Blankets
		—	28.2% Towels
	Payback	—	Approx 4 Years

Table 2: Cherry Tree "Superzone" Tumblers with Crossflow Plate Heat Exchangers.

Cherry Tree Superzone Tumblers

Messrs Cherry Tree have produced a heat recovery assembly which can either be purhcased as an integral feature of a new tumbler, or retrofitted to existing installations. Installations at Bolton General Hospital and Queens Park Hospital Blackburn have been tested and the following results obtained under the "fully drying" mode of operation:

With the Cherry Tree 'Superzone' tumbler it is important to ensure that the lint box seals are in good order as they are prone to damage and the consequent leakage of lint fibres results in the rapid fouling of the heat exchanger surfaces. It is also important to make certain that there is no leakage at the junction of the machine casing with its concrete plinth and it is probable that local sealing of this joint will be required. The observed rate of energy recovery accords with Messrs Cherry Tree's claimed performance of 28% to 30% but at both sites it was necessary to attend diligently to the previously mentioned aspects to secure this successful outcome. Finally, it should be mentioned that the rate of air throughput was reduced by approximately 12.5% subsequent to the installation of the heat recovery equipment. This aspect will be considered at greater length later.

Some important aspects of tumbler drier performance testing

The testing of tumbler drier performance is a relatively complex operation which requires a considerable depth of detail to secure reliable and authentic results. Firstly, the same test load of known dry weight should be used throughout a series of tests and the moisture content both prior to and after tumbling should be established. Overdrying of the test load must be avoided and the end product must contain a small amount of residual moisture even when operating on the fully drying cycle. These precepts were strictly followed in the following tests on a Kamsin 100 lb tumbler and the results emphasize the importance of the preceding statements.

Kamsin 100-lb Tumblers

Testing of a retrofit heat exchanger kit (manufactured by Messrs Ducker Engineering) at St Mark's Hospital Maidenhead by an independent test Authority yielded the result as shown in Table 3.

It will be noted the apparent savings in steam consumption estimated from simplified test procedures are at variance with the more accurate values produced by these more detailed

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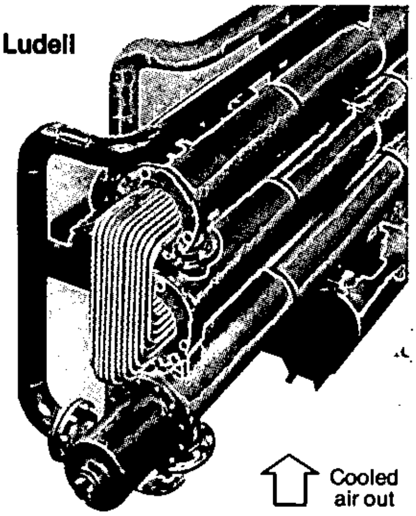

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- Features contraflow system and automatic backflush for self-cleaning

Ducker Tumbler Heat Recovery System

- Saves 30—35% of steam used in tumbler driers
- Reduces overall drying time
- Average pay-back less than 18 months
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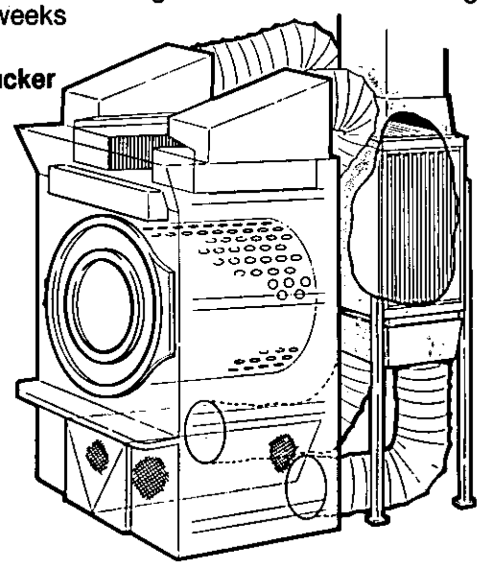
Ducker



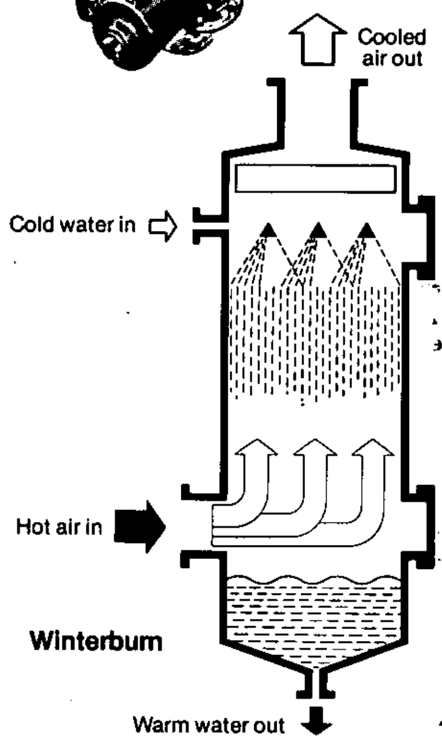


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Table 3:
Tests on Kamsin 100-lb Tumbler (St Mark's Hospital Maidenhead)

(a) Fully Dried Work (Bath Towels)

		Without Exchanger	*With Exchanger*
	Cycle time—Minutes	18	20.5
	Steam used per cycle	126 lbs	89 lbs
	Apparent saving in steam	—	29.4%
Average of 3 Tests	Initial moisture content	57.3%	51.2%
	Final moisture content	4.2%	4.1%
	Moisture removed—lbs	53.1 lbs	47.0 lbs
	Steam used per lb of moisture removed	2.365	1.885
	Saving in steam per lb of moisture removed	—	20.3%

(b) Conditioning Mode (Draw Sheets)

		Without Exchanger	*With Exchanger*
	Cycle time—Minutes	14	14
	Steam used per cycle	75.7 lbs	58.5 lbs
	Apparent saving in steam	—	22.7%
Average of 3 Tests	Initial Moisture content	46.4%	56.7%
	Final Moisture content	13.1%	22.0%
	Moisture removed—lbs	33.3 lbs	34.3 lbs
	Steam used per lb of Moisture removed	2.272	1.704
	Saving in steam per lb of moisture removed	—	25.0%

hence the air 'off' battery temperature is a function of the steam temperature and the rate at which the steam trap can clear the resultant condensate. When a heat exchanger is fitted, the temperature of both machine inlet air and air 'off' battery increases. This increase in drying temperature in isolation results in an offsetting reduction in cycle time.

The combination of these two factors means that the cycle time will be reduced if the air flow is constant but will be increased if there is a significant reduction in fan output. In some instances the two opposing effects may be self-cancelling, and the cycle time remain unchanged. *Graph* 3 suggests that the latter situation is essentially true for the Cherry Tree Superzone installation at Queens Park Hospital Blackburn. The exact outcome on any specific installation is a function of the interaction of the two effects and will vary according to the particular characteristics of the individual machine. Ideally of course, the fan output should be increased to offset the additional system resistances. The increased temperature of operation with the heat exchanger in circuit is readily discernible on Graph 3.

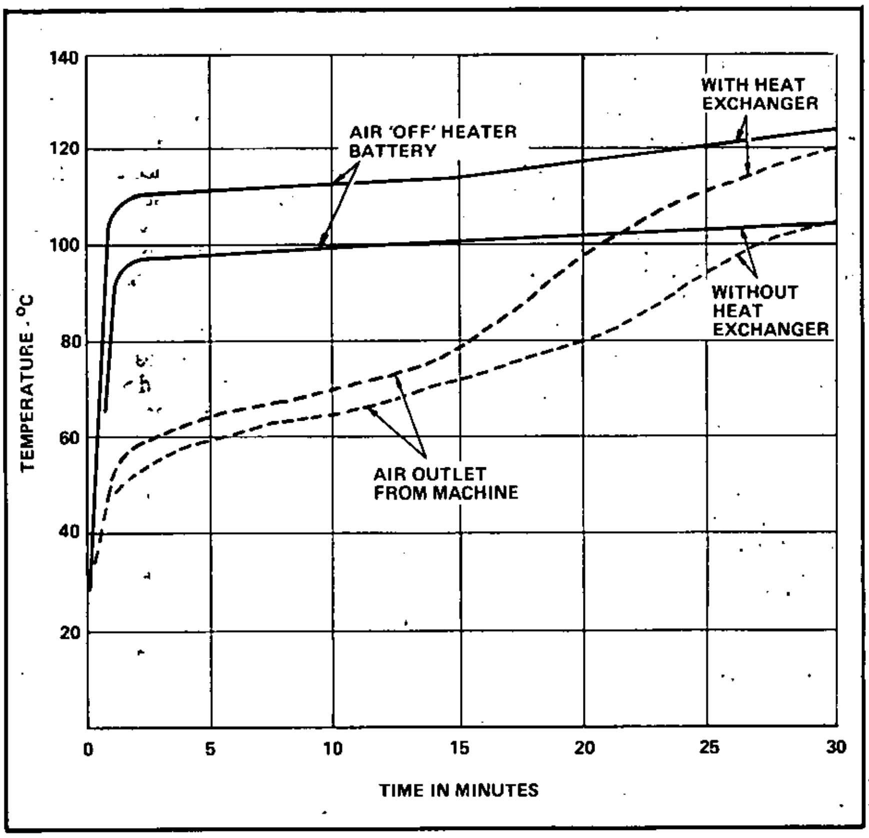
procedures. The latter evidence suggests that this particular equipment produced average energy input savings of about 22.6%. Whilst these values are somewhat lower than the Cherry Tree Superzone tests it is possible that this outcome is the result of basic differences in the test procedures. It was again ascertained that the air throughput declined by approx 12% following the installation of the heat exchanger.

Some constraints of tumbler drying machine design

The operational performance of batch type tumblers is known to be susceptible to any increase in back pressure resulting from the fouling of lint screens. The installation of a heat exchanger to an existing machine with its associated filters causes an increase in air resistance and a diminution of air flow. In isolation, this factor would result in increased cycle times for identical moisture removal.

The air heating batteries on most tumblers are not fitted with any form of automatic temperature control and

Graph 3: Operating characteristics of Cherry Tree 'superzone' with and without plate heat exchanger test load – Blankets (fully drying)



Locally designed tumbler heat recovery projects

There have been a number of locally designed tumbler heat recovery installations some more successful than others. Two of these projects are worthy of specific mention in view of their relevance to points raised above:

Hope Hospital, Salford

This installation which consists of 6 Kamsin 100-lb batch machines was one of the earliest schemes, being completed in July 1980. Each machine is equipped with a crossflow plate exchanger of Swedish origin which gave an initial sensible heat recovery efficiency of 59.2%. Additional supply and extract fans were installed to offset the increased resistance to airflow. As a consequence the project was rather costly but nevertheless an acceptable payback period of 4½ years was achieved. Some fouling and lint filtration problems have been experienced due to inadequate sizing of the filter screens. Regular cleaning by the operator at frequent intervals is essential to maintain the continuity of performance.

Prestwich Hospital

This installation consists of 2 Kamsin 100-lb batch machines and was completed in June 1981. Initially, motorized steam control valves were fitted to the heater batteries in order to maintain the machine operating temperature at its previous level. The cross flow plate heat exchangers (Econovent Type Ex) achieved a 64% sensible heat recovery but have been found to be susceptible to damage by routine cleaning operations. During initial testing is was ascertained that cycle times were extended by approx 30% as a consequence of the reduced airflow, and the steam control valves were therefore removed. Currently, the provision of more robust plate heat exchanger matrices is being investigated. No supplementary supply or extract fans were provided on the installation.

Tumbler driers with contra-flow type plate heat exchangers

The contra-flow type plate heat exchanger illustrated in *Figure 3* is a more efficient heat transfer device than the cross flow exchanger. Sensible heat recovery levels are normally in the 65% to 75% range. Although it is more costly to manufacture, its principal characteristic is that it has a comparatively high resistance to airflow. As a consequence the provision of an additional supply fan is essential.

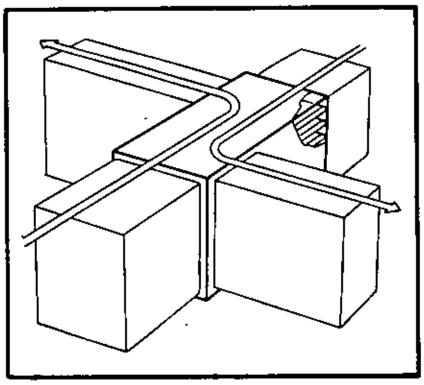


Figure 3: Contra flow type plate heat exchanger.

Despite the higher capital outlay, the evidence to date is that the very high rate of heat recovery results in payback periods at least as good as the retrofit cross-flow heat exchanger packages. The only known tumbler drier installation utilizing the contra-flow type plate exchanger is at New Cross Laundry, Wolverhampton.

New Cross Laundry, Wolverhampton

The two Passat Model 253.20 SD batch tumblers at this laundry have been fitted with Lamanco contra-flow plate exchangers and supplementary axial flow type supply air fans. The recorded heat recovery is 65% to 70% and it is possible that a proportion of this may be latent heat as globules of moisture have been observed on the heat exchanger surfaces during the initial stages of the drying cycle. This film of moisture has a beneficial effect as it assists in the maintenance of a clean heat exchanger.

A typical operational profile for 1 drying cycle is shown in *Graph 4*. It will be noted that the supply air temperature after the heat exchanger is much higher than the exhaust outlet to atmosphere. This feature illustrates the inherent efficiency of the contra-flow type of heat exchanger. Unfortunately steam consumption measurements were not obtained prior to the installation of the heat recovery equipment and hence it has not been possible to establish the amount of steam actually saved. Based however on the sensible heat recovered it is possible to calculate that a payback period of the order of 2½ to 3 years has been achieved. Reports of increased drying cycle times have been received and are being investigated — this may be due to progresseve fouling of the heat transfer surfaces.

Tumbler driers with heat pipe exchangers

Whilst this type of heat exchange equipment has a very high efficiency, the experience of the NHS on 2 initial installations has not been very encouraging. These projects are discussed in the following paragraphs.

Heath Road Hospital, Ipswich

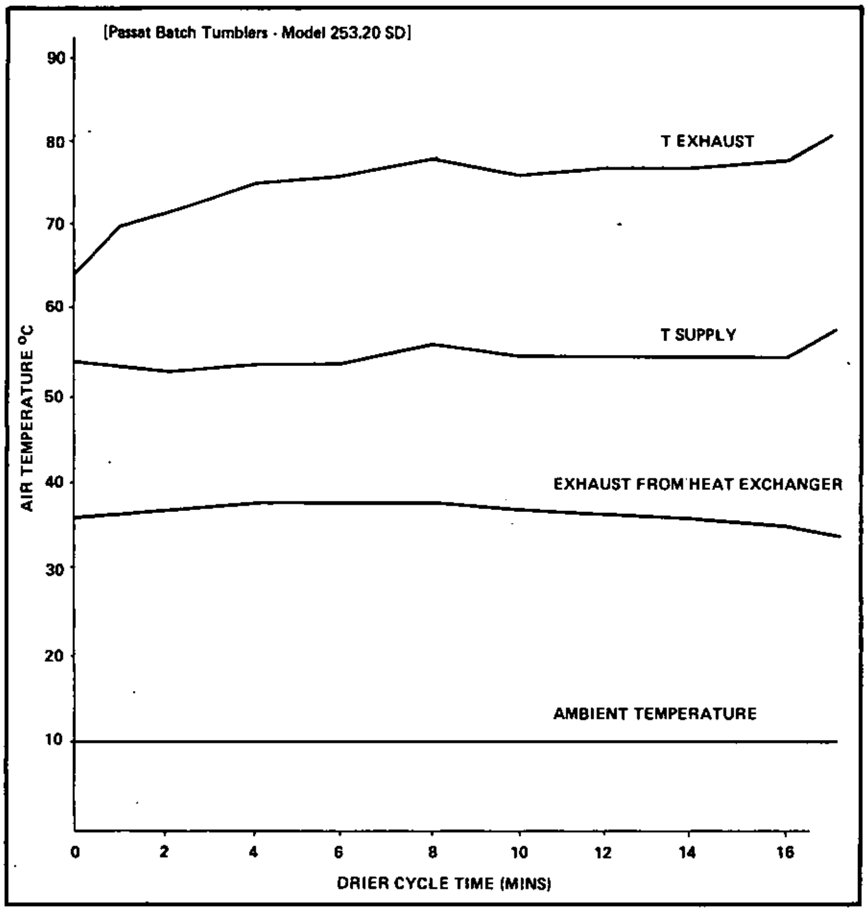
In my previous paper, it was mentioned that a high efficiency quick response exchanger developed by the UKAEA Harwell had been installed for evaluation on an Ortex Continuous tumbler at this hospital. Two major problems were experienced, firstly excessive fouling of heat transfer surfaces due to the very close fin spacing, and secondly a progressive deterioration in performance due to faulty manufacture of the heat pipes.

The above shortcomings were overcome by providing a 3 stage lint filtration system and returning the faulty heat exchanger to the manufacturer's works for replacement of the defective heat pipes.

The performance of the continuous tumbler is difficult to evaluate due to the amount of air loss from the machine to the process area at the open linen entry and exit apertures. The conclusion of the independent test authority after 15 months monitoring was that steam savings of about 17% were being achieved. The trial also demonstrated that lint fouling problems would be a persistent source of trouble unless wider fin spacings were used on production models of the heat exchanger.

Royal London Hospital

Three Passat Model 352D batch tumblers at this establishment have been fitted with 'Q' DOT heat exchangers. The latter have 8 fins per inch on the dirty exhaust side and 14 fins per inch on the clean air intake to reduce the lint fouling problem. On commissioning in March 1981 a sen-



Graph 4: Contra flow type plate heat exchanger, Woverhampton - New Cross Laundry

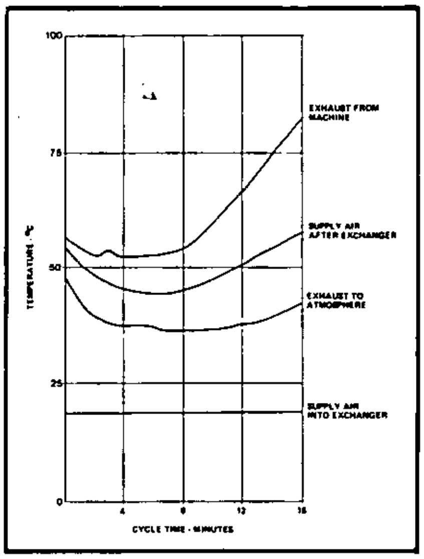
sible heat recovery of 69.7% was achieved but this had declined to about 48% by the end of January 1982. As a result of this deterioration in performance, the drying cycle duration had been extended from 16 minutes to approximately 30 minutes. The operational profiles for March 1981 and January 1982 are reproduced at *Graphs 5* and *6* respectively. In particular it will be noted that the temperature of the supply air after the heat exchanger has fall dramatically over the period.

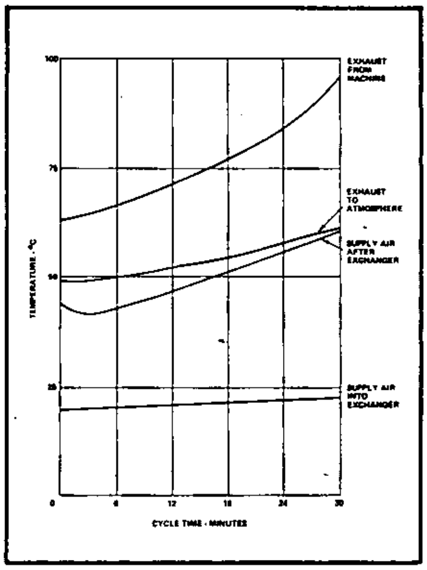
It is not known at the time of going to press whether the decline in recovery efficiency is due to the progressive fouling of the heat exchanger or to defective heat pipes or a combination of these events. Site investigations continue.

Computerized control of tumbler drying cycle time

Microprocessor control techniques have been recently applied to the control of tumbler drier cycle times. The technique which is a development of experience gained in the grass and crop drying field by Messrs Holech (UK) Limited has been advanced to the stage where 3 prototype installations in large NHS laundries have

Graph 5: Royal Liverpool Hospital, Commissioning performance profile - July 1981



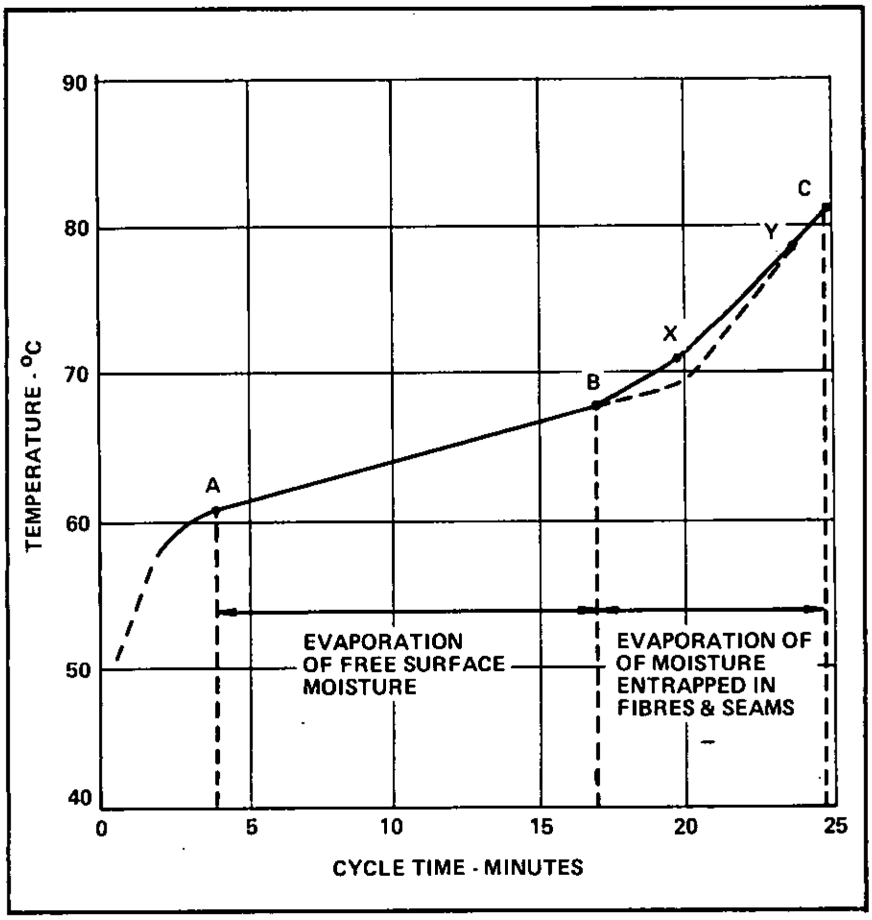


Graph 6: Royal Liverpool Hospital Operational performance profile — January 1982.

been commissioned. The established manual procedure is for the laundry operative to set the tumbler drier cycle time for each load according to its initial wetness and the end product required (ie 'conditioned' ready for calendering/press, finishing or 'fully dried' ready for folding). Since laundry operatives are, by and large, not particularly energy conscious, the drying cycle is normally prolonged and the workload overdried. This constitutes a significant waste of energy.

The philosophy of the computer approach is that each individual tumbler drying machine will have a characteristic drying curve of the form shown at *Graph 7.* The computer scans the machine outlet temperature from Point 'A' onwards and detects the point 'B' at which an acceleration in the rate of temperature increase occurs. The computer stops the tumbler automatically when Point 'X' has been reached if the load is being 'conditioned' or Point 'Y' if it is being fully dried. The action of the laundry operative is reduced to the selection of the 'damp' or 'fully dried' set point.

The three initial NHS installations are at St George's Hospital, Tooting, Eastbourne District General and Knightswood Hospital, Glasgow. Test results so far, indicate that the average drying cycle time is reduced by about 30%, but the exact figure will be a reflection of the ability and dedication which existing operatives currently apply to cycle time selection. Hence the savings could be greater or



Graph 7: Computer control of cycle drying time
Typical curve of exhaust air temperature at machine outlet

less than this value in any other specific establishment.

The cost benefit of microprocessor control of drying cycle time is very favourable, and in large laundries where 6 or more batch machines exist, the payback period appears to be considerably more favourable than straightforward heat recovery.

An instance of spontaneous combustion occurred when fully drying cellular blankets at one of the prototype installations due to the fact that the laundry operator no longer needed to preset the drying time and did not arrange to be available when the tumbler was due to complete its cycle. As a consequence of this event, a visual alarm/warning light will be provided in future installations to indicate completion of cycle.

Tumbler drying machine in patients' clothing launderettes

Whilst the preceding discussion deals specifically with the large industrial pattern tumbler drying machines installed in major laundries, the general philosphy is equally relevant to the smaller commercial type machines found in NHS Patients' Clothing Launderettes. Many of these machines are gas fired and some are electrically heated. Recently a retrofit heat recovery kit consisting of a cross flow plate exchanger, flexible ducting and associated items have become available. This equipment utilizes the heat recovered from the machine exhaust (inclusive of the products of combustion) to preheat the incoming air supply and is marketed under the trade name of "SAVIT" by Comfort Heating Limited of Northampton. Widespread application for this equipment is to be found in coin-operated High Street launderettes. The results obtained from prototype trials at a number of patients clothing launderettes are discussed in the following paragraphs:

Old Windsor Hospital

NYBORG 18 lb/load gas fired machine

A gas meter and an 'hours run' recorder were installed and the following information obtained:

The explanation for the difference in these values is that a by-product of fitting heat recovery equipment is a reduction in the time required to remove a given weight of moisture. This arises from the earlier attainment of the preset working temperature. Manufacturers data indicates that this reduction is of the order of 3 to 5 minutes out of a 20 to 25 minute drying cycle. Evidence of this characteristic is contained in the above test results which show an average reduction in machine operating time of 0.51 hours/day after fitting of the heat recovery equipment (equivalent to 2.5 mins per nominal 20 minutes cycle). As a result of the combined effects of reduced machine operating time and heat recovery, the overall

Table 4.

	No. of Working Days	*Gas Consumption*		*Machine Operation Average Hrs/day*
10/11/81 to 23/11/81 Heat Recovery Unit in Circuit	9	46.52	194.3	4.17
23/11/81 to 30/11/81 Heat Recovery Unit Removed	5	57.22	267.8	4.68

The saving in gas consumption may be expressed in two ways:

(a) Cu. ft/hour of machine operation — $\frac{57.22 - 46.52 \times 100}{57.22} = 18.7\%$

(b) Average daily gas consumption — $\frac{267.8 - 194.3 \times 100}{267.8} = 27.4\%$

Table 5.

	Medium Temperature (Medium Load)				Medium Temperature* (Heavy Load)				High Temperature (Medium Load)			
Cycle Time	20 mins		20 mins		20 mins		20 mins		20 mins		25 mins	
Weight of Load	lbs	oz	lbs	oz	lbs	oz	lbs	oz	lbs	oz	lbs	oz
Wet weight	17	5	17	5	25	5	25	0	15	$0^{3}/_{4}$	14	15
10 15	10	11	17	13	16	15	16	15	9	$14^{1}/_{2}$	9	13
Moisture Removed	6	6	6	10	7	3	8	1	5	$2^{1}/_{2}$	5	2
Gas consumption (cu. ft.)	16.4		19.4		15.7		22.3		17.2		31.45	
Gas used per oz of Moisture Removed	0.1608		0.1830		0.1365		0.1729		0.2091		0.3854	
% Saving in Gas Consumption	12.13%				21.05%				45.48%			

* This machine is most commonly used at or near its maximum rated capacity of 18-lbs at the medium temperature setting.

reduction in gas consumption over the trial period was 27.4%.

The Nyborg machine has 3 levels of temperature settings — 'low', 'medium' and 'high' — and the operator selects the temperature appropriate to the garments being dried. Most patients clothing is of synthetic fibres and the 'medium' setting is mostly commonly used. Since the efficiency of heat recovery is a function of the temperature difference, a number of spot checks were carried out using identical test loads containing identical amounts of moisture in order to establish the performance characteristics at 'medium' and 'high' temperature settings. The results of these tests are set out in Table 5.

It will be observed that there is a wide variation in the saving in gas consumption but the evidence from the spot checks confirms that the efficiency of heat recovery is greatest at the 'high' temperature setting. The observed average results of 27.4% saving in gas over the full trial period of 9 working days thus appears realistic since the normal mode of operation will include cycles at both 'medium' and 'high' temperature settings.

The payback period for this installation works out at just under 5 years despite the relatively low capital cost of £285. This is due to the restricted hours of operation and the relatively small workload.

Glenfield Community Hospital, Leicester

Two HUEBSCH 30-lbs/load gas fired Machines

The two identical machines in this launderette were serviced and set to nominally identical gas flow rates. Each machine was fitted with a gas meter, an 'hours in operation' counter, and an 'hours gas on' recorder. One machine was fitted with the heat recovery equipment and the other was used as a 'control'. The cycle cams were adjusted to give a cycle time of 15 minutes and 20 minutes respectively. The results of a 26 day (18 working days) comparative performance trial are tabulated in Table 6.

The saving in gas consumption of 34% overall (payback 3.1 years) which emerges from this trial is substantially greater than the comparable figure of 27.4% obtained at Old Windsor Hospital. It is suspected that this is due to the significantly longer running hours applicable to the Glenfield Community Hospital with the result that a higher proportion of the drying cycles are performed at the maximum temperature setting. Since the average recorded machine operational hours are in excess of 8 hours per day there is clearly pressure on the launderette operators to achieve the workload throughput.

Norah Fry Hospital — Shepton Mallet

Electrically Heated Westinghouse Machine

The trials at this hospital are currently in progress and to date no positive results have emerged which

Table 6.

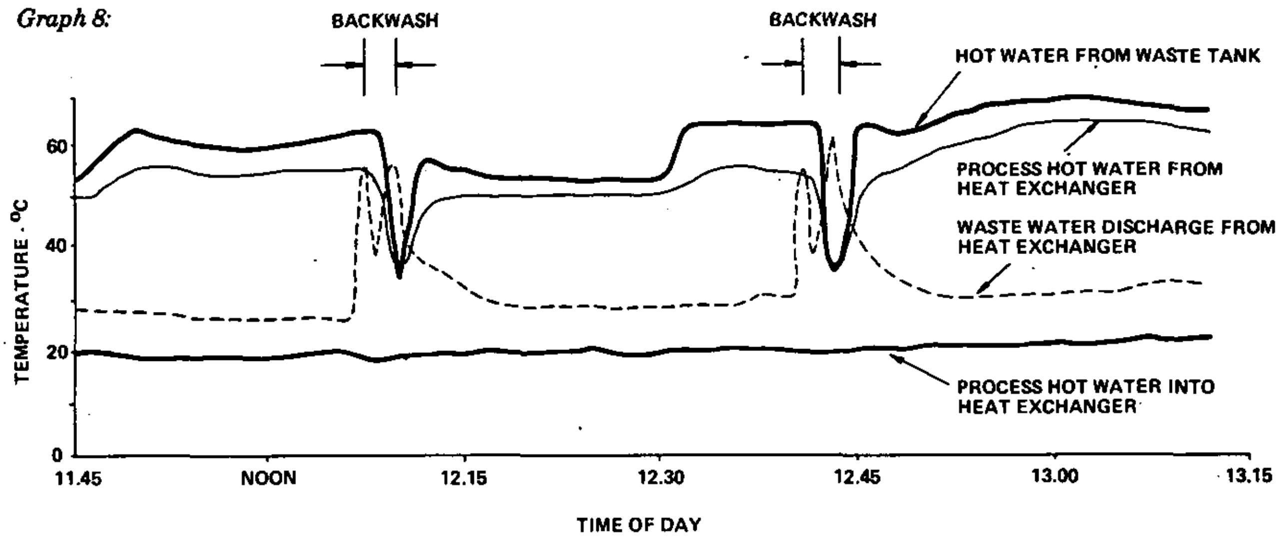
	With Heat Recovery	Without Heat Recovery
Cycle Time	15 mins	20 mins
Machine running time	136.4 hours	155 hours
Period Gas 'On'	47.6 hours	63.8 hours
Gas Consumption	5550 cu. ft.	7160 cu. ft.
Average number of cycles/day	30.3	25.8
Average period of operation	7.57 hrs/day	8.61 hrs/day
Gas used per cycle	10.17 cu. ft.	15.41 cu. ft.
Gas used per hour of machine operation	40.68 cu. ft/hr	46.19 cu. ft/hr

The saving in gas consumption is therefore as follows:

Per hour of machine operation — $\frac{46.19 - 40.68 \times 100}{46.19} = 11.92\%$

Per drying cycle — $\frac{15.41 - 10.17 \times 100}{15.41} = 34.0\%$

Graph 8:



can be reported. The initial tests however indicate that electricity consumption increased after installation of the heat recovery equipment. It is suspected that this unexpected outcome may be because of the increased resistance to airflow of the plate heat exchanger causing air starvation due to extremely tight fitting sizing of the circulating fan. Investigations are in progress to identify the cause of this anomaly and to rectify it if possible.

Heat recovery from wash liquor effluent

My previous paper outlined the Ludell heat recovery system which is of American origin and is marketed in this country by Future Laundry Systems of Banbury. Four installations of varying workload using the Ludell heat exchanger are now in service in NHS laundries, the figures in brackets indicate the number of articles per week. Ormskirk General Hospital (30,000), Warwick General Hospital (70,000), Hull Royal Infirmary (120,000), West Norwich Hospital (185,000). Operational performance data has been obtained from the Warwick and West Norwich installations which are discussed in the following paragraphs:

Warwick General Hospital

(70,000 articles per week)

The washing machinery at this Laundry comprises six Neil and Spencer Model 350 Washer extractors. Segregated channels and dump valves have been provided so that the hot wash effluent may be separated from the cooler rinse waters. The hot wash effluent is discharged to a collecting tank and then circulated through the heat exchanger, where the recovered heat is used to provide process hot water at temperatures varying between 50 and 60°C. It has been found that the recovered heat is adequate for this purpose and that no supplementary steam is required at the calorifier. The laundry process hot water is thus totally provided from the heat in the effluent.

This laundry operates a twilight shift and the amount of heat recovered over the 12 hour working days averages about 4 million BThU/day. The exchanger performance over a 1½ hour period is shown on *Graph 8* — the proximity of the process hot water temperature at the outlet of the heat exchanger to effluent inlet temperature indicates that the exchanger has a recovery efficiency approaching 90%. The graph also indicates that automatic back washing is taking place at approximately half-hourly intervals. The efficiency of this latter process was revealed by a physical inspection of the heat exchanger tubes after eight months continuous operation — the tube surfaces were clean and entirely free of fatty acids, soap scums or other deposits. The payback period achieved by this rather expensive retrofit installation in a relatively small laundry has been calculated at four years.

Two operational features of importance have emerged from this prototype installation which need to be borne in mind on future installations of this type. Firstly, that the rating of the effluent extract pump must be tailored to suit the flow of waste water into the collecting tank. At Warwick it proved necessary to reduce the pump capacity so that it operated for a total of approximately 9 hours/day.

Secondly, since the process hot water storage tank is cool at the start of the working day due to the closure of the steam valve at the calorifier, it is important that the first loads are hot washes (ie cotton sheets or similar) and not polyester fabrics requiring reduced processing temperatures. The importance of this constraint has been recognized by the laundry operating staff and the resultant change of procedures has not caused any untoward difficulty.

Since cold water is used for both initial and final rinsing at Warwick laundry it will be evident that the washing process is now an energy efficient operation.

West Norwich Hospital

(185,000 articles per week)

This laundry is much larger than the Warwick installation with the washing machinery consisting of 3 Baker Perkins Tunnel washers and 8 washer extractors of assorted size. All effluent including both hot wash and cool rinse waters pass into a common collecting tank.

The initial method of operation was to utilize the heat in the effluent to preheat the cold feed to the process hot water calorifier. Due to interaction with a flash steam recovery system, the effluent extract pump operated for less than 2 hours of the 12 hour working day and the majority of the hot effluent overflowed the tank weir and passed to drain. Heat recovery

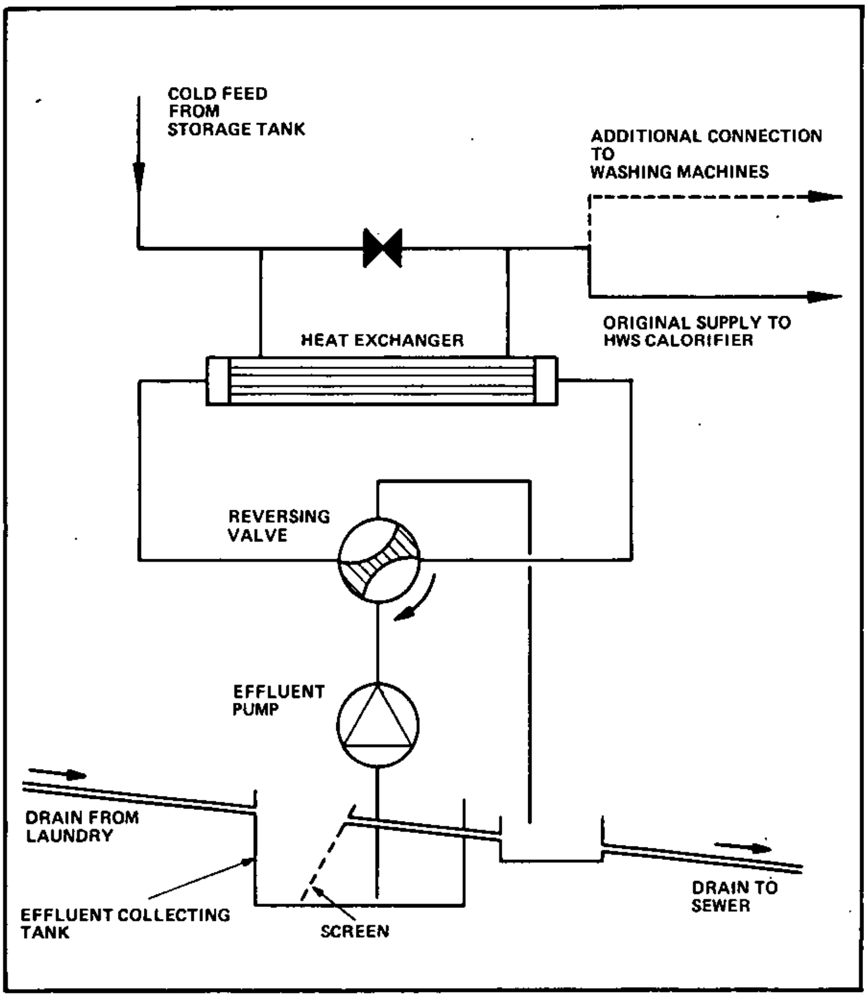


Figure 4: West Norwich laundry, Effluent heat recovery system

amounted to approx 6.8 million BThU per day under this mode of operation.

The cold water pipework was subsequently modified so that a tepid supply of water could be made available to the washing machines. This relatively small conceptual alteration increased heat recovery to approx 27.2 million BThU per day and resulted in the near continuous operation of the effluent pump. There is now a negligible overflow of hot effluent over the weir of the collecting tank. The pipework layout is shown schematically at *Figure 4*. The provision of a tepid supply at 30/35°C to the washing machines resulted in a proportionate reduction of the amount of steam injection at the machine. The payback period for this scheme is calculated at 3.05 years.

The operational experience at this site highlights the importance of ensuring at the design stage that there is true balance between the amount of heat which can be recovered, and that which can usefully be utilised. In particular, where tepid supplies are used for initial wetting out of machine loads it is important that the temperature of the process water does not exceed 40°C (104°F) in order to avoid stain setting problems. This constraint may necessitate the use of blending valves at the machine inlet for the breakwash water intake.

Alternative heat recovery systems

An installation utilizing the AERCO exchanger (of the American origin, but marketed in the UK by British Steam Specialities) has just been completed at Park Prewett Hospital, Basingstoke. The heat exchanger is of the shell and coil type with the hot effluent passing through the shell and the clean water through the tubes. The shell is mounted on runners and quick release connections are provided for easy withdrawal. Initial operating experience shows that weekly cleaning by the use of high pressure steam/water nozzles is necessary. Operational data and experience on this installation is now being accumulated.

Reports have been received of an alternative European system which is stated to be operating satisfactorily in 4 laundries in Sweden. This system which is marketed under the trade name of Spraytec can also be used in a combined manner to give both heat and water recovery. The limited constructional details available indicate that the system includes self-cleaning filters which require periodical replacement of the membranes. These are believed to be expensive.

Optimum system of laundry processing for heat recovery

In large laundries where the washing machinery consists of a mixture of tunnel washers and washer extractors there is no real alternative to collecting all effluent (wash and rinse waters) and using the recovered heat to preheat the laundry cold water supply. This enables all recoverable heat to be used to advantage. In the smaller and medium size laundry where the process equipment consists of washer extractors it is possible to use either hot water or cold water for the two rinse cycles or a combination of the two methods — ie cold first rinse and a hot second rinse. There has been considerable recent debate which is the most economic process in terms of energy consumption when heat recovery from the hot effluent is provided. The equation is neither simple nor straight forward since account needs to be taken of the fact that hot water rinsing shortens tumbler drying time and reduces steam consumption in the intermediate section of the laundry.

Whilst I am not in a position to answer this conundrum, a theoretical study based on a typical 200-lb washer extractor which starts initially with cold water fill and rinses and utilizes the recovered heat to raise both hot and cold water to tepid conditions gives the following theoretical energy consumptions for successive cycles:

After the sixth cycle, the energy reduction stabilizes at about 45% of that used in the first cycle as a result of the increased process water temperature and the increased percentage of the total energy requirement which is provided from recovered heat. The overall energy saving based on 12 washing cycles per day is about 37.5% in the wash house section of the laundry. *Graph 9* shows the progress-

Cycle	Process Water Temperature °F	Heat Input BThU/Cycle	Saving Over First Cycle %
11	50	200,380	NIL
2	84	158,220	21
3	103	134,660	33
4	113	122,260	39
5	119	114,820	42
6	122	111,100	44
7	124	—	—

ive increase in process water temperature and its eventual stabilization at around 124°F. As yet we have no laundry following this specific operational policy but Ormskirk laundry, which is currently closed for extension and re-engineering, utilizes this approach and will provide in-service data and experience when it comes back into service towards the end of 1982. It should then be possible to make a direct comparison between the relative wash house performances of this installation and Warwick General Laundry which operates on the alternative process of cold water rinsing and heat recovery from the hot wash effluent only.

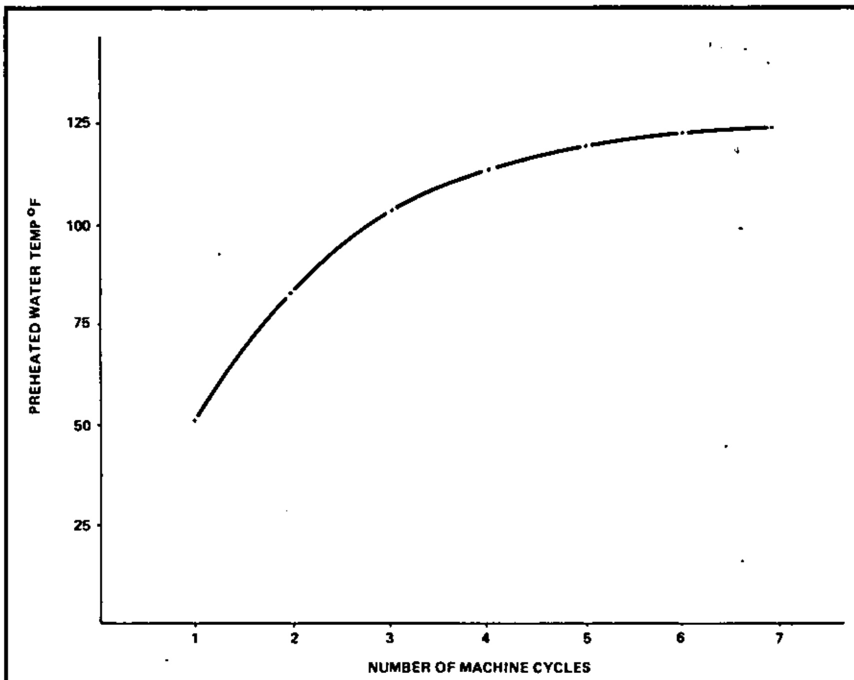
Conclusions

The successful installations which have been operating in the past 2 years indicate that heat recovery from dirty laundry effluent is both a practicable and an economic proposition. Clearly this technique should be embodied in all new laundries and suitable existing laundries when major extensions or upgradings are taking place. It is however of paramount importance that the interaction with existing flash steam recovery systems is taken into account as it is pointless to recover more heat than can be usefully utilized within a particular installation.

The application of spray-type recuperators

This is a highly efficient type of heat recovery device particularly when large quantities of latent heat in moisture vapour is available. The construction of the device is shown

Graph 9: Effluent heat recovery on washer extractors, theoretical increase in process water temperature



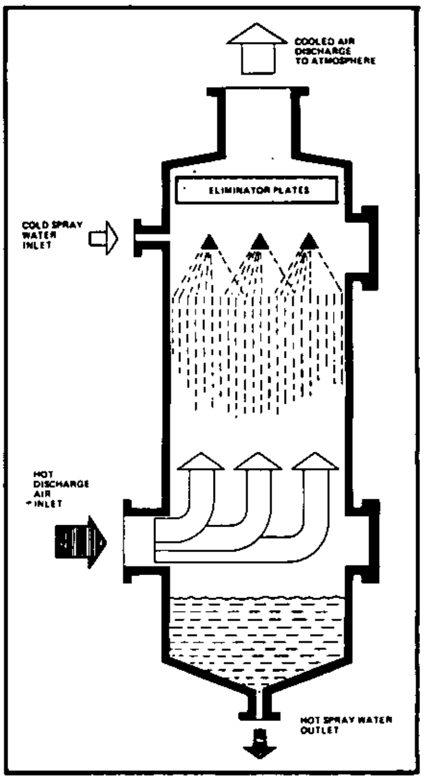


Figure 5: Typical Spray Recuperator

at *Figure 5.* The most common application of this device is to recover waste heat from the flue discharge of gas-fired boilers. Brentry Laundry at Bristol utilizes this device in a conventional manner and the results are of particular interest.

Conventional installation at Brentry Laundry

This laundry is a self-contained installation on an industrial site and is served by three gas-fired Stone's Vapour boilers of which two operate in parallel to meet the steam demand. The workload averages around 100,000 articles per week, but there has been a steady increase in recent months. The washing machinery consists of one tunnel washer and six washer extractors.

An Icco spray type recuperator was installed on one boiler in November 1980 as an energy conservation measure and is used to provide both process hot water and preheated cold water to the laundry. The pipe layout which is shown schematically at *Figure 6* allows the heat exchanger to feed either laundry cold water supply (when draw-off is taking place) or alternatively, when there is no demand, to feed direct into the storage cylinders. This arrangement allows the maximum use to be made

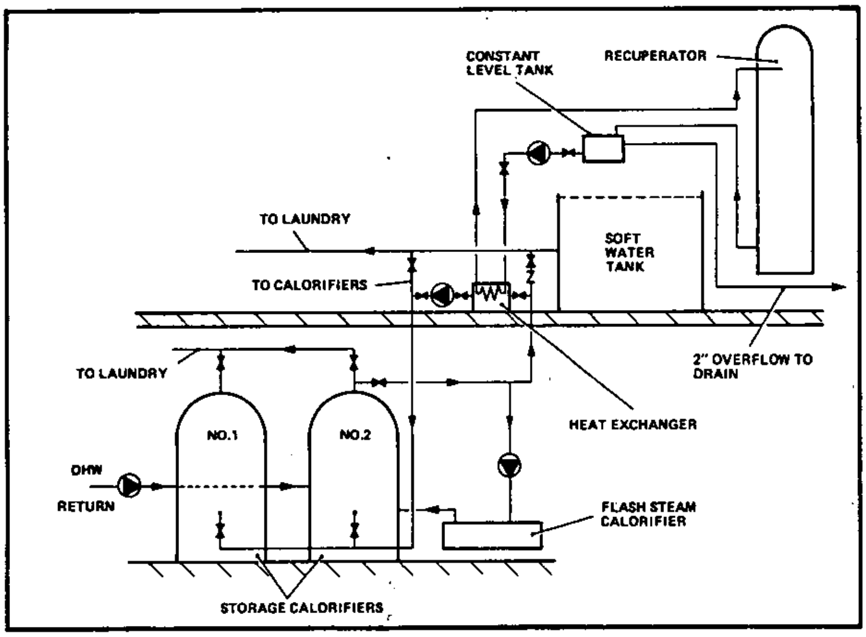


Figure 6: Schematic layout of pipework at Brentry Laundry

of the comparatively large quantities of low grade heat available at the recuperator. Since the recuperator came into service, the direct steam inlet valves to the storage cylinders have been shut off and the recuperator, supplemented by a flash steam recovery system, has provided the total process hot water for the laundry at an average temperature of around 120°F (± 5°F).

The resultant fuel saving during the first complete year of operation was equivalent to 13.7% of the laundry gas consumption and the payback period is 2.1 years. The key to this highly successful performance is that the re-engineering of the process hot water system enables full advantage to be taken of the copious quantity of low grade heat which is available from the recuperator.

Table 7.

(i) **Warwick Laundry** (3 ROLL x 120 inches WIDE MACHINE)

Test 1 — Pillowslips
Air Entry — 600 cfm at 197°F DB and 107°F WB
Spray Quantity — 26GPM heated from 52°F to 61°F
Heat Recovery Rate — 140,000 BThU/hour

Test 2 — DrawSheets
Air Entry — 600 cfm at 182°F DB and 116°F WB
Spray Quantity — 24 GPM heated from 52°F to 64.5°F
Heat Recovery Rate — 180,000 BThU/hour

Test 3 — Cotton Sheets
Air Entry — 600 cfm at 192°F DB and 140°F WB
Spray Quantity — 23 GPM heated from 52°F to 80.6°F
Heat Recovery Rate — 394,680 BThU/hour

(ii) **Commercial Laundry** (5 ROLL x 144 inches WIDE MACHINE)

Roller Towels (not previously tumble dried)
Air Entry — 912 cfm at 147°F DB and 145°F WB
Heat Recovery — 110,000 BThU/hour up to 482,000 BThU/hour (varies according to Spray Quantity)

(iii) **Prison Laundry** — (THERMAL FLUID HEATED MACHINES)

Air Entry — 1650 cfm at 225°F DB and 141°F WB
Spray Quantity — 40 GPM from 50°F to 95°F
Heat Recovery — 1,080,000 BThU/hour

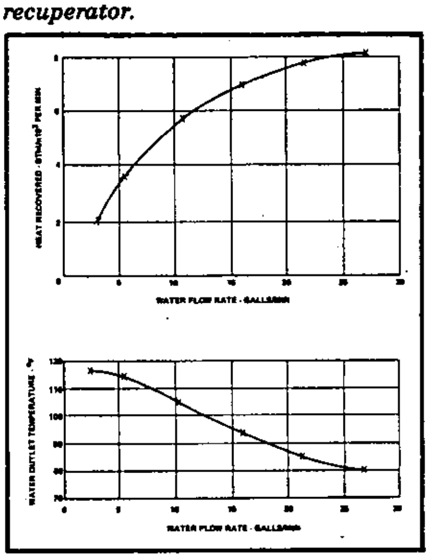
Experimental application to calender exhaust air

Uncertainty has existed for a long period about the amount of heat contained in the hot moisture laden air discharged by the suction fans which are fitted to calender rolls. It was not known whether this heat was recoverable or whether when recovered it would be sufficiently high grade for use elsewhere in the laundry. In co-operation with Future Laundry Systems of Banbury, basic research work has been undertaken at Warwick Hospital Laundry and by courtesy of this firm the following table of results (which also includes a Commercial Laundry and a Prison Laundry) is made available.

The tests at Warwick Laundry disclose that a significant amount of low grade heat is recoverable and there is some evidence of the amount recovered being proportional to the workload throughput. The Test 3 figure of 394,680 BThU/hr however appears unduly high and it is suspected that this is a peak instantaneous value caused by a batch of very damp cotton sheets passing through the machine.

At the Commercial Laundry roller towels straight from the washer extractor were being processed and hence the calender was operating under near steady load conditions. A series of trials at various spray water flow rates were run to obtain the relationships between the following parameters, (i) Spray water flow rate and amount of heat recovered, and (ii) Spray water flow rate and temperature of the outlet water.

Graph 10: Heat recovery from calendar roll air discharge using a spray recuperator.



The characteristic curves for these relationships are shown at *Graph 10.* It is apparent that the magnitude of the heat recovered falls dramatically with a reduction in flow water quantity and also that the latter results in a significant elevation of the outlet temperature until a peak of 115°F is reached. The increase in heat recovery with larger flow quantities is due to the increased amount of latent heat which is removed when the hot discharge air is cooled to lower saturation temperatures and accords with basic psychrometic data. The investigation has thus established that there is a choice of recovering a comparatively large quantity of low grade heat or alternatively recycling a much smaller quantity of higher grade heat.

The tests at the Prison Laundry are of interest in that the direct fired thermal fluid heated calender operates at much higher temperature levels than the conventional steam heated calender and consequently the dry bulb temperature of the discharge air from the rolls is considerably greater than that emanating from the traditional machine. This factor results in a considerable increase in the amount of medium grade heat which can be recovered.

Having established that it is possible to recover useful amounts of heat from calender exhaust air, consideration must be given to the point of re-injection into the laundering process. Firstly, the quality of the spray water is sufficiently high for it to be reusable directly in the washing process without the necessity of passing it through a secondary heat exchanger. It thus appears that this heat source could be used for first stage recovery prior to effluent heat recovery or used in tandem with the latter system. It will not be possible however to provide a categoric answer on the feasibility of this suggestion until specific design investigations have been carried out on typical NHS laundry installations.

Calenders and flat work ironing machines

The previous sections of this paper naturally lead into the subject of heat recovery and energy conservation on calenders. Whilst generally speaking this area of the laundry is the most difficult in which to produce significant energy savings there has been one development which offers promise for the future. Before however dealing with ironing machines of advanced design it is convenient to consider the current calender heat shields and plastic hoods and to place their energy savings in perspective.

Shaped insulated heat shields and plastic hoods

The traditional laundry calender is a large and bulky machine with a high radiation heat loss which contributes significantly to the unpleasant environmental conditions which are usually prevalent in the finishing areas of NHS Laundries. The two currently accepted methods for the reduction of this unwanted heat emmission are the provision of shaped insulated heat shields to each calender roll, and the installation of a plastic hood which covers the entire bed area of the machine (including rolls).

In view of the rather extravagant claims made by certain manufacturers it was decided to carry out field trials on 2 calenders which had been fitted with heat shields for energy conservation and environmental purposes. These test were carried out with the calender in operation but without any workload passing through the machine. The results were shown in Table 8.

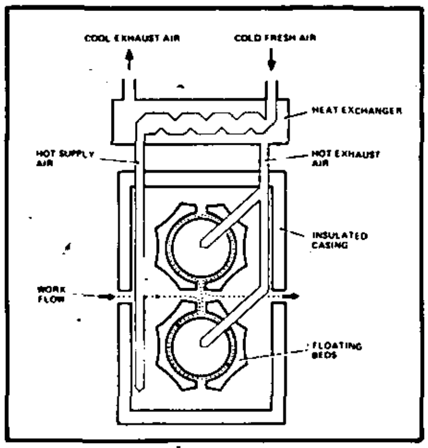
Attempts to confirm these figures by testing with the calender working under normal conditions of operation were abortive at both sites due to the very small saving and the large variation in linen feeding rate and moisture content which appertain during routine operation. The evidence is that the energy savings are very small although they will be applicable whenever steam is turned 'on' at the calender and irrespective of whether the machine is passing workload or not. The simple payback period for both installations was about 11 years. The inference from these investigations is that whilst the provision of insulated heat shields for energy saving alone cannot be justified using current economic criteria, there may be a valid case for their installation where environmental conditions in the finishing section of a laundry need to be improved.

No formal tests have been carried out on removeable plastic hoods but a similar performance level is anticipated. In this connection, the author would appreciate performance data on any installation on which local testing has been carried out.

Calenders of advanced design

About a year ago a continental flat work ironing machine of advanced design was introduced to the UK market by Messrs Broadbent. The significant features of this machine are shown at *Figure 7.* The two roll model has its rolls mounted horizontally above each other and the linen feed follows a figure of 8 pattern so that the angle of contact with the roll surface is increased to approximately 340°. The beds are suspended and automatically maintain a constant pressure against the rolls. The machine

Figure 7: Ferrum Ironer - Marketed in UK by broadbent



Central Laundry, Chichester
(4 ROLL MACINE)

Heat shields removed	–	337 lbs/hour steam flow rate
Heat shields fitted	–	303 lbs/hour steam flow rate
Reduction in consumption	–	34 lbs/hour

Atherleigh Laundry (3 ROLL MACHINE)

Heat shields removed	–	186 lbs/hour steam flow rate
Heat shields fitted	–	164 lbs/hour steam flow rate
Reduction in consumption	–	22 lbs/hour

assembly is completely housed in an insulated casing which is removeable in easy sections for maintenance access. The exhaust air from the rolls is passed through a heat exchange unit consisting of a heat pipe exchanger and a condensate cooler before being discharged to atmosphere. The recovered heat is used to preheat the air input to the machine. This design is thus intrinsically energy efficient and has the further advantage that long warm up periods are not required. The machine is very compact and the 2 roll model is claimed to have the capacity of a 4 roll conventional ironer due to the increased contact area. A further advantage is that the linen flow path results in the work piece being polished on both sides.

Two of these machines have been installed in NHS laundries (Greenbanks, Plymouth and St James', Leeds) and provisional arrangements have been made for performance testing and verification of the manufacturer's claim that savings in excess of 30% of the energy used by conventional calenders can be achieved.

Whilst a number of initial teething problems inherent to any new advanced design have been experienced, the principal problem in setting up the performance tests has been to obtain a feeder which can maintain a throughput rate of 1,000 sheets per hour. The latest information is that the teething problems are being overcome and it is hoped that the performance trial will commence shortly.

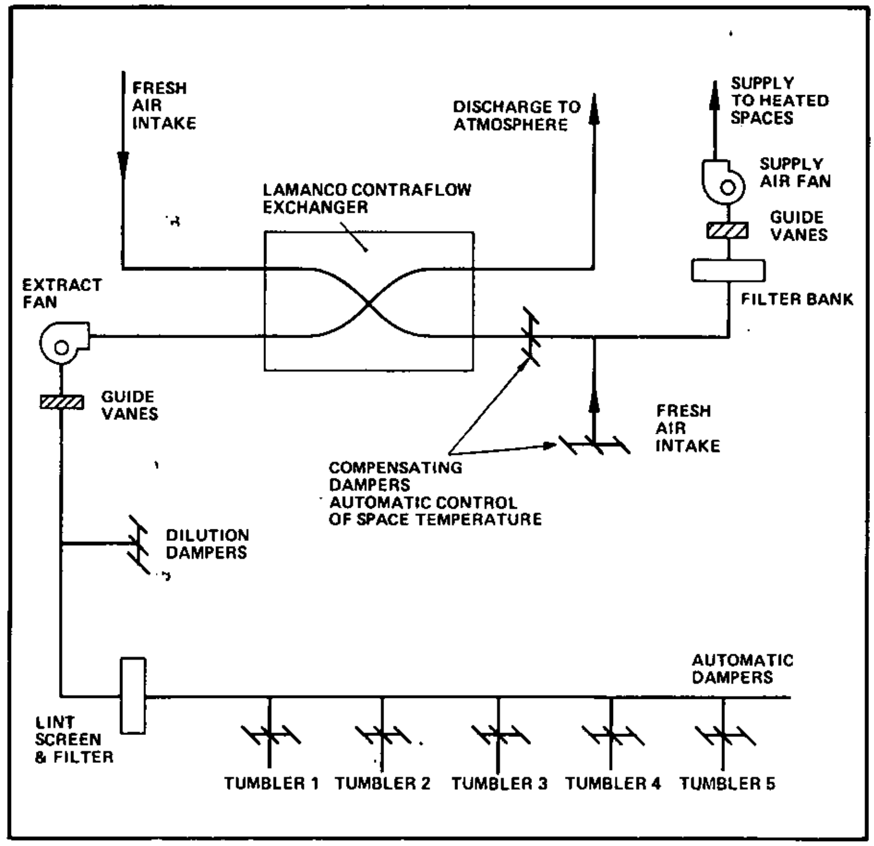


Figure 8: Manor Hospital – Walsall, space heating from tumbler drier exhausts

Laundry space heating from recovered heat

Although there is very little demand for space heating in the main laundry hall there is a requirement during the winter months for heating in the reception and sorting bay, packing and despatch area and ancilliary spaces such as sewing room and offices etc. The Manor Hospital, Walsall has undertaken two useful projects which utilize waste process heat for space heating.

Space heating from tumbler drier exhaust

The exhaust from 5 batch tumblers is passed through a Lamanco contra-flow plate heat exchanger prior to discharge to atmosphere. Clean outside air is heated in this heat exchanger and blended with the requisite amount of outside air before passing into a plenum system which serves the Reception/Sorting area and the main laundry hall. The system is represented schematically at *Figure 8* and shows the automatic dampers which shut off individual tumblers when they are not in operation. The dilution dampers shown on the exhaust air duct prior to the heat exchanger is a safety feature designed to protect the in-line fan against excessive temperature damage. The system was commissioned in January and the plate heat exchanger produced a sensible heat recovery of 69%.

Space heating from air compressor radiators

Two 30 kw screw type compressors provide compressed air to the laundry. The waste heat dissipated from the radiators of these machines will be used directly for the space heating of the Packing/Despatch area and Sewing Room. The necessary provision has again been made in the engineering service layout for the automatic control of the space temperatures and the bypassing of the hot radiator discharge air direct to the ambient when the space heating requirements are satisfied. Sound attenuators have been provided to prevent the transfer of noise from the machinery room to the heated spaces. This scheme is at present at the constructional stage with a target date of December 1982 for completion.

Whilst these two schemes are the most ambitious yet undertaken, the use of waste heat from tumblers for space heating means that over a whole year only a limited proportion of the recoverable heat will have been recylced. An alternative approach would be to make full use of the recovered heat to reduce the tumbler steam demand at all seasons of the year. However, the engineering concept of both projects is fundamentally sound and is to be commended to others who elect to pursue this application of recoverable heat either in laundries or in other health care buildings.

Preheating of laundry process water from tumbler drier exhaust

The next project for discussion is mainly of historical interest in that it was completed in 1979 prior to the advent of standard retrofit kits for tumbler drier heat recovery. At the Queen Elizabeth Hospital, Gateshead, lint deposition from tumbler exhaust air on surrounding land and privately owned buildings was creating a nuisance. It was therefore decided to provide lint filters and to simultaneously incorporate a heat recovery system into the common discharge duct from the tumbler driers. The heat recovery equipment comprises a closed circuit air to water coil which transfers the recovered heat in the primary fluid via a secondary shell and tube heat type heat exchanger to the cold feed serving the main process hot water calorifier. The principal design parameters are shown in table 9.

This system has given satisfactory service and in addition to eliminating the original nuisance has achieved a payback period of less than three years on a capital outlay of £8,076 which includes the roll filter costs.

Table 9:

Extract air 'off' tumblers	—	17,500 cfm at 160°F
Air temperature after reclaim	—	100°F
Primary water inlet temperature	—	80°F
Primary water outlet temperature	—	120°F
Primary water flow rate	—	47 GPM
Process water inlet temperature	—	55°F
Process water outlet temperature	—	112.6°F
Design recovery rate	—	1,134,000 BThU/hour

One drawback of this project is that its completion effectively prevents the future use of heat recovery from hot laundry effluent, unless there is another fortuitous local use for recovered heat. However in view of its early completion date and subsequent technical developments this observation could only have been made with the benefit of hindsight. Nevertheless the lesson to be learned from this experience is that heat recovery schemes should not be designed piecemeal but should form part of an overall strategy for the laundry installation.

Automatic self cleaning lint filters

Recently, automatic self cleaning filters designed specifically for the removal of lint fibres and floc from descharge air have become available. The filter assembly consists of a lint arrestor screen on which the lint particles accumulate. Periodically, mechanical sweeper brushes driven by an electric motor remove the collected lint from the screen and deposit it in the integral collection hopper at the base of the unit. The associated control panel incorporates a sweeping frequency adjustment facility. The fractional horse power drive motors run on average for less than 30 seconds per hour, hence running costs are minimal.

Three of these units have been installed on tumbler drier exhausts at Hull Royal Infirmary and highly favourable reports have been received on their performance. The incorporation of this type of equipment is clearly worthy of consideration when tumbler heat recovery systems are being planned.

Swindon Low Energy Laundry

The final example in this survey of laundry energy conservation progress is the new 120,000 article per week laundry now under construction at Swindon. This project forms a suitable conclusion because it incorporates within a single project most of the techniques outlined in this paper.

The background to the project is that the existing laundry is due for demolition as part of a road improvement and highway development scheme. The replacement laundry is sited on an industrial site and will be provided with its own oil fired boiler plant and transformer substation. Hence all energy used on this site will be within the laundry and subsequent performance monitoring should be a relatively simple operation. In particular, the apportioning problems which normally arise when laundries are supplied from hospital boiler plants and electricity networks will be completely avoided.

Wessex Regional Health Authority undertook the detailed design of this project 'in house' with an initial objective of reducing the overall steam consumption from the present level of 3.5 lbs/article in a modern well run laundry to an average figure of 2.25 lbs/article. This aim is equivalent to a 38% reduction in energy consumption. Subsequently the Department of Energy agreed to support the scheme as an 'Energy Conservation Demonstration Project' and to meet the costs of fully monitoring the operational performance over a 2 year period.

The washing machinery comprises one 13 stage and one 8 stage modern tunnel washers together with 3 washer extractors. The detailed design of the engineering services and the process plant incorporates the following energy saving features. (i) Batch drying tumblers (2 off) — integral heat recovery by individual plate heat exchangers. (ii) Tunnel finishing machines (2 off) — integral heat recovery by individual plate heat exchangers. (iii) Wash liquor heat recovery — used to preheat 3000 galls/hour of rinse water to 95°F. (iv) Flash steam recovery plant — low pressure steam vapour used to heat 8 stage tunnel washer, process hot water and space heating calorifiers.

The current forecast is that these measures will meet the design objective and result in an average steam consumption of approx 2.1 lbs/article assuming efficient management of the process equipment when the laundry comes into service.

It should be noted that traditional calenders have been incorporated in this project — this decision was taken due to the absence of proven operational performance data for the more advanced design machine, described earlier when the scheme was under preparation. However, automatic release of ironing machine bed pressure has been incorporated to reduce losses when no work is being processed. The project also includes a 'Spiratec' steam trap leak detection system to ensure that steam trap malfunction is immediately identified. This feature is of importance in view of the closed nature of the steam/condensate system.

Whilst this particular laundry is the most energy conscious design yet produced, the pace of development in the laundry energy conservation field is such that it will be out-of-date when it comes into service. Nevertheless, this design is a model of what can be achieved within current cost limits and is an example of the standard of design provision which should be made in all new laundries and major upgradings currently on the drawing board.

In conclusion, may I suggest that the level of saving aimed for at Swindon is easily attainable given present knowledge and should be the minimum objective for all current designs.

This article first appeared as a paper at the Institute's Symposium on Hospital Linen Services in June 1982.
The author is the Laundry Adviser to the Central Services Agency for the Department of Health and Social Services, Northern Ireland.

Hospital Linen Services Symposium Paper

Effective Management

R H LAW

Introduction

I intend initially to outline the areas in which management is exercised and then establish what I understand by the term 'effective management', thereafter proceeding to consider the various factors which control or influence effectiveness and to look more closely at one common area. Common, that is, to both Hospital Engineers and Hospital Linen and Laundry Services Managers.

We are both involved in the work of non-business institutions. Management is work and, as such, it has its own skills, its own tools and its own techniques. But management is also people. Any achievement of management is the achievement of a manager, likewise every failure of management is the failure of a manager.

We must never forget that it is people who manage rather than 'forces' or 'systems', it is the vision, the dedication and integrity of a manager, which determines whether there is management or mismanagement.

In the last analysis management is practice. Its very essence is not in knowing, but in doing.

During the last eighty or so years, society in developed countries has become a society of institutions, and on the performance of those institutions the performance of modern society increasingly depends. Business has undoubtedly grown in the past eighty years but institutions have grown much faster.

The hospital, formerly an institution to which the poor went to die, has become the centre of health care and a giant in its own right. Management studies have, to date, been mainly directed to the business section because that sphere alone has measurements for the allocation of resources and for the results of decisions. Profitability is a far from perfect measurement, and yet, despite its imperfections, it is a measurement. In the non-business institution such as the NHS we have Opinions, Fixed Ideas and Yardsticks to work by instead of measurements.

Once again we face new challenges in Organisation Structure. In 1948, that is thirty-four years ago, we knew, or thought we knew, all the answers about organisation and structure. Now in 1982 we have to admit we do not even know the questions!

Fifty years ago it was considered that a manager was one who was responsible for the work of other people. Twenty-five years ago we had the 'production explosion'. The hospital laundry catchphrase was, 'well washed and reasonably finished,' and every manager was expected to be production minded. The manager's efficiency was gauged by the volume of work his department produced within a given period of time — usually a working week. Little or no consideration was given to the type of plant, the mix of workload or indeed the standard of processing or finishing.

Fifteen years ago 'cost effectiveness' became the watchword and, without fully understanding the implications, comparisons between the year ended audited returns of one laundry were compared with the returns from another. It was a time consuming exercise, completely unenlightening, engaged in by many and useless to all.

Quite recently Government has made odd noises about privatisation — or for the sake of those among you who prefer plain English —the putting out to commercial contract of hospital laundry work. Again comparisons are being invited and we are in danger of assessing a manager's effectiveness by the ability to record a lower cost per article than the commercial charge per article. A straight comparison of two dissimilar matters which must produce a nonsense answer.

Managers in the NHS, as elsewhere, are paid to make resources productive, not to produce work at a certain cost. In ensuring that all the resources available to him are used in the most productive way, the manager must have regard to the exacting requirements of both process and finishing which the service dictates. Enlarging upon this point, it is nice and comfortable and fills one with a sense of doing good to refer to the patient as our customer, but a moment's reflection will show that this is not, in fact, so. A customer chooses a service industry such as a laundry because it offers a desired standard of work at an acceptable price. A hospital patient receives a standard of service selected by other people and is at best the recipient of a service in which he or she has no say.

The 'other people' who determine the standard of service are Finance Officers, Purchasing Officers, Prevention of Infection Officers, Bacteriologists, etc, etc, etc.

I would express my understanding of Effective Management in the hospital linen and laundry services discipline as being *the exercise of management skills in such a manner that the technical requirements of handling and processing are fully met and the agreed standard of finish is achieved by the productive employment of all available resources.*

The Work Force

A major resource of any manager is, of course, his work force. In the last twenty years or so the work force has changed qualitively. The least educated members of today's labour force are infinitely better educated than their predecessors. In management jargon, many of today's work force are 'knowledge workers' as opposed to 'muscle workers' and there is a tendency to make little demand of them and give them small chance of contributing. This problem has yet to be clearly thought out and we must reach the point where the knowledge worker is so managed that he is not only productive but is called upon to contribute and achieve. Unless management creates jobs which allow for this we will, given an upsurge in the economy, face the problem of increasing staff turnover because of absence of job satisfaction.

In 1974, when speaking in London, Peter Drucker, the management consultant and well known writer who has been a major influence on management practices of today, had this to say, "A well managed plant is a quiet place, a factory that is 'dramatic' a factory in which the epic of industry is unfolded before the visitors eyes is poorly managed. A well managed factory is boring. Nothing exciting happens in it because the crises have been anticipated and been converted into routine."

Bearing this in mind let us, for a moment, consider the difficulties and constraints which the Service places upon its linen and laundry services managers.

Functional Councils

Functional Councils are a necessary evil in these days of negotiation and arbitration. It is here that matters such as rates of pay, holiday entitlement, sickness allowances and provision for absences are determined — the manager has no part in these negotiations, neither do other managers in the Service. Yet the laundry manager knows that with a given number of patients in the hospital, X thousand articles of clean serviceable linen are needed each week, and he is expected to achieve this target. If over generous absenteeism is not enough to contend with, there is the confused and confusing matter of Disciplinary Procedures. These matters have been negotiated and agreed and for the present must be lived with — at times they make life very difficult.

HM71 (49)

With the issue of the document entitled *Hospital Laundry Procedures* we enter a new era of processing — no longer a straight-forward British Launderers Research Association wash process such as had been in general use until that time. It was now necessary to extend processes — increase temperatures so as to ensure adequate thermal disinfection and ensure the subjection of the washload to the correct temperature for the proper duration of time. In addition, the Medical Sub-Committee on Sterilisation and Disinfection who produced this document had considerable foresight in that they anticipated the Health and Safety at Work etc. Act making recommendations for the packaging and transporting of Foul/Infected Linen in such manner as to exclude portering and laundry staffs from direct contact with the potential health hazard.

Bonus Incentive Schemes

This introduction, designed initially to ensure a higher take home pay for the ancilliary worker, Bonus Incentive Schemes, soon became the 'in-thing'. Managers who did not utilise Management Services Feasibility Studies, Lead-In Payments and Implementation Schemes were looked upon at least as poor managers, indeed in many cases ineffectual managers.

Evening Shift Working

Evening Shift Working followed last in the train of bonus schemes and brought their associated problems of factory occupancy and plant utilisation for up to fourteen hours per working day.

Having endeavoured, despite these matters, to strive for Peter Drucker's 'boring factory' where all crises have been anticipated we suddenly discover Low Flammability with add on chemical treatments, inherent low flam fibres and a whole range of non-starters in the field of textiles — some unfortunately purchased before adequate practical user and launderability trials have been carried out. There has to be a spin off from every new development and many of the inherently low flam fibres brought with them static problems. Ironing machines which had been too fast at 70 fpm were too slow at 85 fpm and the feeders thought they were breaking records at the lower speeds!

This problem is still with us and is unlikely to be resolved until we have discovered the correct material from which to manufacture our bed linens and soft furnishings. Correct that is, in that it is of low flammability, of satisfaction in use and is capable of being laundered en masse.

Before leaving this section, dealing as it has with service imposed difficulties, one which has arisen in the last two years is well worth mention. These years have brought financial restraints of a level not previously experienced. In numerous cases because of budgetary miscalculations administration has imposed an embargo on overtime working. In a business producing for stock such a move might be acceptable and indeed prudent. In a non-business institution it is a certain road to trouble. Hospital laundries are frequently operating at a constant 14% staff absentee rate and the week's requirement of produce is obtained by overtime working. The imposition of 'no overtime' means that all too often staff anxious to maintain output introduce short cuts in processing or finishing. Quality standards fall below predetermined levels and there is still a shortfall in production. In such cases the rationing of linens becomes the manager's responsibility and consequently he receives the full weight of opprobrium launched upon him by consumer interests — not that this matters a great deal. After all it is part of what he is paid for and anyone essaying a career in management soon learns to accept complaints however unfounded they may be, or he gets himself out of the business.

From what has been said it will be apparent that effective management demands not only the requisite knowledge of the technical aspects of laundering and its associated involvement with textiles, but also the knowledge of management skills and techniques, and most important of all, the will to apply this knowledge. I would here repeat — "the essence of management lies not in knowing but in doing."

Management of a section of a service, if carried out in isolation, must fail to be effective, in fact in most cases such action becomes mismanagement. Management calls for Planning and effective Planning requires Foresight and Consultation with others. The others may, themselves, be Managers with their own Departments and their own peculiar problems, but it is with other Managers that discussions on Planning can prove most worthwhile and effective.

Machine Down Time

I would like to consider a common problem — common in that it arises in all laundries — common in that it is of considerable frequency — common in that it is general knowledge. I refer to machine down time or those periods during laundry working hours that a machine which should be productive is for one reason or another not operable. These occurrences are generally, if vaguely, termed 'Mechancial Breakdown' or 'Stoppages' and inevitably they lead to lost production. If loss of production cannot be tolerated there are increased labour costs for overtime working at enhanced rates of pay. Staff will, in general, respond to a reduction of machine availability by endeavouring to maintain output. Cutting corners for this purpose is common, especially if an incentive bonus scheme is in operation, but cut corners can mean not merely a reduction of quality standards as would result from finishing articles in a drying tumbler and hand folding in place of ironing and machine folding. If the problem is in the washroom it is more likely that saving of process time will result in disinfecting temperatures not being attained or if attained not held for the appropriate length of application — a hazard to patients and staff throughout the hospital.

Accepting that even with the selection of the correct machine in the first instance — with the application of the highest possible standard of preventative maintenance — and with a fair share of luck, there are still going to be occasions on which an otherwise trustworthy tool ceases to function.

It would be ideal, if not always realistic, to have the appropriate maintenance staff 'standing by' in the laundry to immediately tackle an incident. Recent enquiries have shown that fewer laundries now have on site maintenance staff than was the case 15 years ago. This appears to me to smack of bad planning, or are we in the Health Service so prodigal of public monies that we can countenance non-productive machinery? Certainly in the larger laundries equipped with machines of high hourly output where there is no spare capacity and machines out of action means the loss of many kilos of production, the presence on site of a maintenance team is essential for effective management. It is a simple matter to record lost machine time and the cost of making good the lost production — in seven cases out of ten it will be found that the annual cost is less than the cost of on site maintenance.

A few years ago (1976/77) a survey involving 28 laundries was carried out over a twelve month period. The intention was to determine *fact* as distinct from the *belief* that certain types of machine 'broke down' more frequently than others. What was clearly established was that of nearly 900 incidents recorded the major 'management complaint' in 82% of the cases was not the time taken to rectify the fault but the time which expired before the necessary skilled personnel arrived to attend to the problem. I am sure you will have all heard at some time or other that well worn statement — "the necessary spare part was not available." (I am never sure if this means not available in the appropriate hospital store or not available from the manufacturer.) In the aforementioned survey the lack of spares only accounted for some 6% of the delays recorded. A wider and more detailed examination of this field would obviously be a worthwhile project.

Conclusion

I have claimed that effective Planning requires Foresight and Consultation, in particular consultation with other Managers with their own Departments and their own problems. Engineering is a Science and like laundry management it has strong elements of a Craft. In the NHS it also calls for management techniques and skills. Effective Management must foresee the crisis and eliminate the problems. Effective Management must enter into partnership with other managers.

In conclusion, I would like to quote from a paper which was given at the 1968 Conference of the Society of Hospital Laundry Managers. The speaker was John Bolton — at that time the Regional Engineer, East Anglian Regional Hospital Board. His closing words were — "It is an unfortunate fact, but a true one, that many engineers and managers do not appreciate a very simple yet most important factor of relationship. This is 'two way appreciation'. The engineer must learn to appreciate the problems which face the manager — to put himself in the manager's shoes, so to speak — and the manager must also learn to appreciate the problems which face the engineer. By doing this they will be better able to solve their problems to their mutual satisfaction and produce a more effective service."

Product News

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Closing Date:- 27th August, 1982.

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