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Practical Environmental Advice for Business

EN30

# Finding hidden profit


# 200 tips for reducing waste

# *Summary*

**Reducing material waste at source means greater resource efficiency, less pollution and more profits. Each pound saved on material costs goes straight to the bottom line. Reducing waste has always been a profit opportunity; in today's consumer, economic, ecological and regulatory environment it is becoming a necessity. For many companies, sooner or later, waste will become a survival issue.**

The good news is that many wastebusting steps can be taken quickly - *without* major capital investment.

This Guide presents the combined experience of clients and consultants, working together to reduce waste in a wide variety of industries. Over the years the principles and practices presented here have saved companies millions of pounds.

The first part of the Guide introduces the general wastebusting approach. The second part gives practical tips based on industrial examples. It is designed to be dipped into to stimulate ideas rather than to be a comprehensive manual.

The responsibility for tracking waste lies with all departments of a company, but, in particular, the management team who can effectively drive and co-ordinate waste minimisation.

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## What is waste?

There are literally hundreds of words for different types of waste - see Appendix 1 for just some of them - each giving waste a spurious air of respectability. Do not think that you don't produce waste simply because it has another name. Whatever you call it, waste is waste: take the opportunity to cut waste and increase profits!


## Why you should do it

### What does waste cost?

**1** **Companies rarely add up what waste is costing them.** Waste disposal may be a substantial cost for your business. When you consider the materials that are in the waste, and add the cost of treatment, energy and wasted labour, the real cost of waste is often 5 - 20 times the cost of its disposal.


**2** **Wastebusting improves profit.** Reductions in waste go straight to the bottom line in a way no other type of cost improvement does. Since raw materials are often 30 - 60% of turnover, the effect on profit of better utilisation can be dramatic.

**3** **Waste reduction pays back in months.** Typical waste reduction projects have payback periods of months rather than years. In four UK regional demonstration projects, most waste reduction opportunities gave paybacks of less than one year and many of these cost little or nothing to implement.

## Zero waste principles

**4** **Prevent pollution at source.** Reducing waste at source is not only the best way to prevent pollution, it is also the most cost-effective. Recycling and treatment carry higher costs and can lead to pollution, while dumping or discharge usually carries the highest cost of all.

**5** **Waste is avoidable.** Disposing of wasted materials represents defeat. Responsible disposal of waste is important but it serves only to limit the damage - however carefully we dispose of waste, we can't help damaging the environment to some extent. Clearly, avoiding waste creation is the best way to protect the environment.

**6** **Waste can always be reduced.** At all times, in all processes, waste can be reduced. Where the payback seems poor, consider again whether all the costs have been taken into account and bear in mind that disposal costs, material costs and external pressures for improvement will continue to increase.

**7** **Matter is neither created nor destroyed.** The key to understanding material losses is the mass balance. Calculate the weight of materials consumed in production and subtract the weight of material that should be in the goods produced. The difference is the loss. Some of the loss will be visible in the waste streams, some will be invisible. Accounting for all of it will help you understand the cost - and the opportunity awaiting you!

**8** **Effects really do have causes!** Detective skills are the first requirement of a wastebuster! The real causes of waste are not always obvious and explanations of causes may not be correct. Good analytical skills, a keen nose, a willingness to challenge existing perceptions and tenacity will all be needed in the search for the real causes of waste.

**9** **Control the process to control the waste.** Once the cause of the waste has been identified, improving control of the process will often reduce it. Some processes are out of control. Others are controlled only by the skill and knowledge of experienced operators who often know better than the process control manual. Improving process control by tapping into people's skills and experience will enable you to make changes that stick.

**10** **Feedback pays back.** People from shop-floor employees to senior management are motivated by feedback that tells them how well they are doing in reducing waste. Introduce yield and waste monitoring but pay particular attention to the people close to the process. They are the ones who can react quickly enough to prevent waste. Monitor, measure and react.

**11** **Accuracy = low waste = quality.** The wastebusting approach requires accuracy, control, communication and attention to detail. These form part of any quality improvement, TQM or Just-In-Time programme. Concentrating narrowly on finished product quality or throughput may actually increase waste by increasing rejects at inspection. Wastebusting is in tune with quality improvement because it is about preventing defects by improving process control.

**12** **Employees support zero waste.** All employees are in favour of improving quality and cutting waste. Increased environmental concern is sharpening enthusiasm for finding ways to waste less. It is part of good waste management to encourage and build on that enthusiasm.

## Where are you now?

**13** **The stairway to zero waste.** Where are you on the stairway? At the bottom are companies for which waste is not recognised as an issue, at the top are those which have eliminated waste rigorously at all stages in their processes.

Most companies are stuck somewhere in the middle. Waste has become an issue but the benefits are not being realised. Many can climb to the top within one or two years, realising much of the benefit from existing plant and equipment.

*To see where you are on the stairway, go to Appendix 2 which contains a self-assessment guide.*

# Getting started

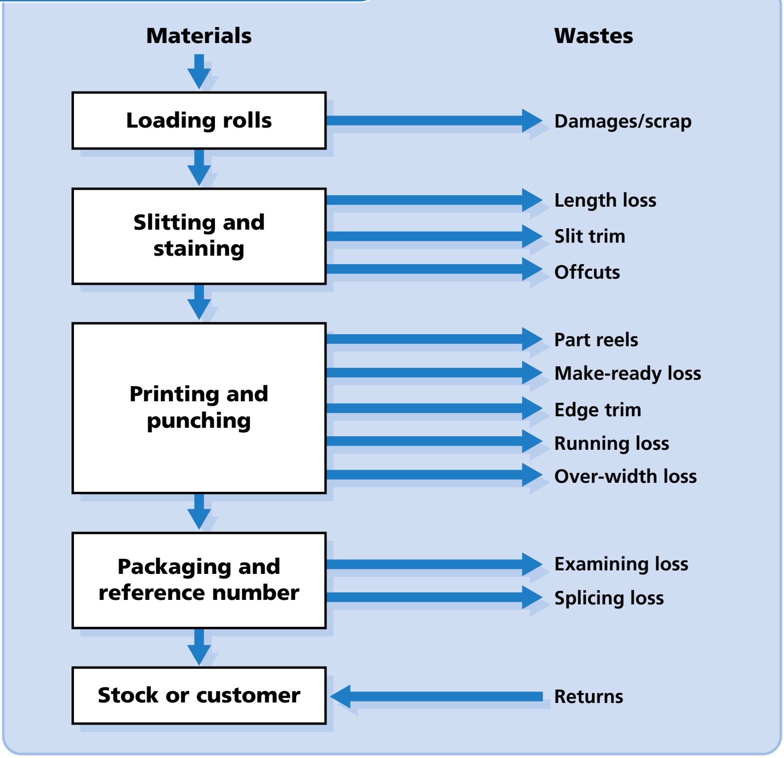
**14** **What's needed first, second and third for successful wastebusting?** Top management commitment, top management commitment and top management commitment!

## Surveying and waste auditing

**15** **Waste auditing means accounting for waste!** The financial angle is why the word *auditing* is used. Waste auditing is the first stage in waste reduction, taking stock of the waste problems, identifying opportunities, setting targets and making plans.

**16** **A flowchart is worth a thousand words.** Making a flowchart of material and waste flows is the best place to start. Once the flowchart is right, start trying to put numbers on it for amounts and cost. You may be surprised how complicated the flows are and you may have to start digging for hard numbers.

***Fictitious packaging flowchart***



**17** **Weight can't balance volume.** The flowchart is the starting point for a mass balance. You cannot make a mass balance if inputs are measured in kilograms or metres while outputs are in product units. The only way to balance is to convert to a common unit.

**18** **When does a mass balance?** What you are aiming to do is to first measure the total mass input to the process, then the mass output of good product and known wastes, and then find the difference. The difference between known inputs and known outputs is the total loss. You then measure all the individual waste streams including overweight and try to account for all the loss. The measure of success for a mass balance is an invisible loss of less than 1% of purchases, but this level of accuracy is not always possible.

**19** **Zero waste is the standard.** Allowances for material losses are often hidden deep in the inner workings of accounting systems. This means standard usage of material often includes a hidden allowance for waste. This may be acceptable for accounting purposes but hides the true costs. Mass balance calculations start from a zero waste base-line.

**20** **Take stock of waste.** Mass balance calculations should include stock gains and losses, so use a period between two stocktakes as the basis for your calculations. Remember:

- Material consumption = purchases + opening stock - closing stock
- Production = (sales - returns) + (closing finished goods stock - opening stock)

Accurate stocktaking is important for an accurate mass balance - stocktaking errors can distort the mass balance calculations.

**21** **What is in your waste streams?** Waste streams usually contain most of the raw materials lost from the mass balance, but how much? Water, cleaning solvents, packaging and other waste may also be in there. Sampling and temporary monitoring of waste flows may be needed to estimate the composition of each stream.

**22** **Moisture misleads.** Any process which uses water gives rise to difficulties in quantifying waste. In the first place the consumption in products, as distinct from that used for cleaning or domestic uses, is often badly recorded. Also, moisture content may change during processing. Often in these circumstances it is simpler to do a mass balance based on bone-dry inputs and outputs.

**23** **React to chemical yield losses.** If chemical reactions are involved in the process, it is important to understand how this affects the mass balance. Polymerisation reactions release water which is then 'lost' from the process. Adjust raw material yield loss calculations for these reaction losses.

**24** **What is your Emby?** Mass Balance Yield, or MBY (Emby), is weight of production divided by the actual weight of virgin material used. MBY can range from 99% down to 30% or less. It is a useful benchmark measure and can provoke some interesting questions when sites making similar products are compared. MBY can be increased only by converting more of the raw material into finished product.

**25** **What is your Efty?** First-Time Yield or FTY (Efty) measures how much is produced right first time. It is the production divided by the total inputs to the process (including rework). FTY is invariably lower than MBY but the difference varies considerably from industry to industry. FTY can be increased by reducing recycling within the process or by improving MBY (or both). Remember, rework is an additional cost penalty. Therefore:

**FTY = MBY** is the goal.

**26** **Hunt the 'invisible' losses.** Once you understand from a mass balance what is missing, the next task is to find the 'invisible' losses or mass balance difference. Follow through all the implications of your calculations. Do process losses tie up with quantities disposed of? Measure waste figures by two or more different methods and reconcile the answers. You will often find surprises. (More hints can be found in Tips 62 - 68 **Hidden waste**.)

### Calculating waste costs

You may want to do this in stages as shown below.

**27** **How big is the whole COW?** Calculate the full Cost Of Waste, or COW:

COW = MBY cost + FTY cost + Other waste related costs

The total cost of waste is often 5 - 20 times more than the disposal costs alone and can range from 5% to 20% of the costs of production. The cost of waste can be higher than the direct labour bill! Which of these costs do companies usually have better knowledge and control of?

**28** **Emby cost.** A good first measure of waste cost is the MBY cost. It is calculated from the MBY (see Tip 24) - expressed as a percentage - and the annual cost of materials:

MBY cost = (100 - MBY) x Annual cost of materials / 100

**29** **Refining the Emby cost.** The MBY cost can be refined by calculating the loss cost for each raw material class separately where there are big differences in price; for example, calculating ink and paper losses separately in a printing process:

Total MBY cost = MBY cost for paper + MBY cost for ink

**30** **Efty cost.** The next step is to include the cost of processing the material up to the point where it is lost from the process. The Efty cost is calculated from the FTY (see Tip 25) - expressed as a percentage - and the annual cost of running the process:

FTY cost = (100 - FTY) x Annual cost of running the process / 100

**31** **Add waste-related costs.** The final stage is to add other waste-related costs. Include: process losses, stock losses, quality losses; the costs of wasted capacity, cleaning materials, waste handling equipment and containers, disposal and transport charges; and the cost of labour associated with these activities. You will also need to add the cost of compliance with reporting requirements, legal costs and liability insurance.

## Structuring your plan

### Setting waste reduction targets

**32** **Waste is not inevitable.** Ban a few phrases when you start setting waste reduction targets:

Unavoidable waste! Natural waste! Paid for waste! Costed waste!

Waste is waste - cutting it will increase your profits!

33 **What is the best we have done in the past?** The best performance you have achieved in the past is one point of reference for setting new targets. You know it is achievable because you have already done it once.

34 **What should we be able to achieve?** Go beyond the best and look at the ideal. What stops you getting there? Identifying barriers to improvement is the first step in overcoming them.

35 **Who will take responsibility for achieving the targets?** It is important that waste reduction finds a champion with enough seniority to make things happen. Waste minimisation can cut across lines of responsibility. Achieving change can mean persuading others to set new priorities or to commit resources. Waste minimisation means managing change. More information about this is available in GG27 *Saving money through waste minimisation: teams and champions*, available free of charge through the Environment and Energy Helpline on freephone 0800 585794 or via the Envirowise website (www.envirowise.gov.uk).

36 **Are the targets ambitious enough?** Unambitious targets can be demotivating. If senior management loses interest in them they cease to be a challenge. Set targets that are realistic yet challenging and maintain the challenge from shop floor to senior management.

## Waste performance monitoring

37 **If you don't measure it, you can't manage it.** Measurement of performance is key to control and motivation. Measures may be needed at several different levels: at the process to improve immediate control; at a diagnostic level for analysis and problem solving; and at a management level for performance monitoring. Monitor, measure and react.

38 **How to choose your measure.** Measurement of performance is not always an easy task. Measures should be accurate, timely, simple, understandable, relate to cash savings and be comparable over time.

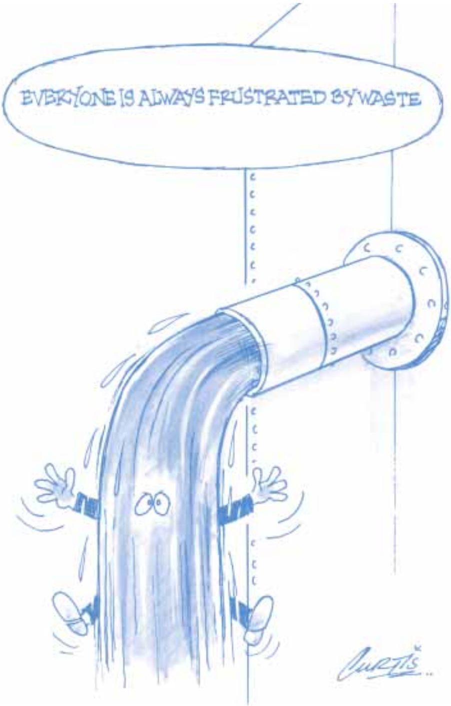
39 **Make the producer pay.** Money is a great motivator and detailed monitoring of waste streams gives the opportunity to charge relevant production departments for the disposal of the waste they generate.

40 **Report waste as % of production.** Relating waste to throughput in the statistics is not only a very useful way of monitoring progress over time, it is also of considerable help in setting budgets and settling disagreements.

## Involving people

**41** **I'm glad you told me about that!** Encourage people to tell you about waste problems and act on them. A good manager will never criticise if waste is brought to his attention. Don't blame the messenger or the perpetrator. It is better to find out later than never.

Concentrate on the solution. Be seen to act! Make waste important! Many workforces do not see environmental issues as threatening. Indeed, prompt attention in this area can be highly motivating.




**42** **Don't keep costs secret.** People often don't appreciate the value of the materials they are handling, because they haven't been told it. Talking about savings in £s is more meaningful than quoting percentages.

**43** **Tools.** Provide people with the right tools for the job. Poor tool design or having to make do can lead to waste and reduced motivation.

**44** **Tune in, listen and learn.** Tap into people's skills and experience through teamwork and cause and effect sessions. Listening to people can have a powerful motivating effect on them - and you will also learn what is really happening.

**45** **Empowerment - breaking down barriers.** At a recent waste team meeting, cause and effect diagrams were used to help a group of managers identify causes of waste. 'Oh, but most of those are outside our control,' said one and gave an example. 'No, I disagree, we can control that one,' said another. One by one the causes were all identified as being in the control of one or more of the managers in the room. By working together they realised they could tackle all the problems. This is empowerment in action.

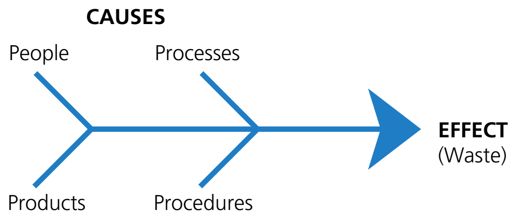
**46** **Can you afford not to train?** American management guru, Drucker, said of staff, 'If you think trained is expensive, just try ignorant!'.

**47** **Improve housekeeping.** An untidy factory is a wasteful factory. Untidiness leads to mistakes, poor attitudes, accidental damage, obsolete material and waste.

## Problem-solving techniques and tools

**48** **Fishbones help teams link cause and effect.** Cause and effect charts (also known as Ishikawa or fishbone diagrams) are a great way to discuss and identify causes of problems in a teamwork session. A mixed group of process operators, engineers, managers, laboratory and technical staff discuss the causes of a particular process problem while a skilled facilitator chairs the discussion. The fishbone diagram is a useful record of the thinking. Changing facilitators for different problems is a useful training technique to involve more people directly.

The ideas flow thick and fast once the session gets going.




**49** **Use problem-solving teams to develop solutions to waste problems.** By starting a team off with a cause and effect session (see above), you develop the shared understanding that is needed to go on and develop solutions to waste problems. More than any other technique, well-run team sessions can help in identifying improvement opportunities, creating involvement and communication, and improving understanding.

**50** **Use Pareto analysis.** Pareto analysis is commonly known as the 80:20 rule or ABC analysis - 80% of the symptoms are caused by only 20% of the problems. Using Pareto analysis is a lever for getting results quickly.

Make a bar chart of waste causes to see in what order you should tackle the problems.

**51** **How to crack tough nuts.** Some process problems resist solution by traditional 'change one thing at a time' methods. Production can involve many, many inputs and processes each of which is a potential source of variation. The best way to crack tough nuts like this is to put aside the theory and find out what the process itself is telling you.

Through statistical analysis of what the process is doing you will start to get clues. Talking to operators gives you more key information, as does detailed observation. By using designed experiments and running trials on live production you will get the solutions direct from the process itself.

The right combination of determination, a practical but scientific approach and people skills can crack the toughest old nuts.


**52** **Taguchi - design of experiments.** Taguchi techniques, including factorial, partial factorial and mixture experiments, can be used on live production processes and are very effective for optimising process conditions and improving control. For an introduction to Taguchi methods see *Designing for Quality* by Lochnar & Matar (Quality Press). Industry case studies are contained in *Taguchi Methods - Applications in World Industry* by Bendell, Misney & Pridmore (IFS Publications).

**53** **The Taguchi loss function.** Taguchi proposed the radical idea that producing products in tolerance is not enough. The total loss to society (the consumer, the firm and the environment) is minimised by reducing variation around the optimum. This concept neatly links waste minimisation to improving process control. A more advanced book on broader aspects of Taguchi techniques is *Quality by Design* by Nicolo Belvendram (Prentice Hall).

## Invisible losses

### Product giveaway

**54** **What is given away as overfill, overcount or overweight?** Giveaway of 1 - 2% is often accepted. This invisible waste is the most common cause of invisible losses. You may also be receiving less than you pay for. The first step is to establish the value of this opportunity to increase profit.

**55** **Cost giveaway.** In a chocolate biscuit process, underweight biscuits may be brought up to target weight by increasing the amount of chocolate. This can be expensive.

**56** **Count errors.** Longcount errors can occur when packing multiple flavours (eg of crisps or snacks) into a multibag. Count errors can occur when a packet is held up in-flight causing a shortcount followed by a longcount. The shortcount will be rejected by the checkweigher, leading to rework and packaging waste, while the longcount is given away to a lucky consumer.

**57** **Does that bottle look full?** Die differences on multi-die moulding machines can produce different capacity bottles. When these need to be filled to give a minimum visual fill, the filler has to be adjusted to the largest bottle and so gives away the maximum on all bottles.

**58** **Weigh them all in and count them all out.** Many food products are sold by weight but packed by number. Examples are confectionery and biscuits. Good control of both counting and product average weight are needed to minimise giveaway.

**59** **Zero Overfill is legal and feasible.** The ℮-label standard applies to most consumer goods sold by weight or volume in Europe. The standard is in three parts:

- average net weight to be no less than stated net weight;
- no items to be more than 3% underweight;
- 98% of items to be no more than 1.5% underweight.

With proper maintenance and operation it is possible to achieve Zero Overfill and conform to the standard.

**60** **Use ℮-label standard for all products.** Industrial products are not subject to the same regulations as retail products. The ℮-label standard can be adopted by industrial suppliers as an internal standard to insure against customer complaints and eliminate overfill.

**61** **Check tare weights of packaging.** Tare weights on packaging labels may be incorrectly stated leading to inaccurate setting up of filling machines. An example: a stated drum tare weight of 18 kg was actually 17.55 kg which led to 0.45 kg per drum overfill.

## Hidden waste

**62** **How much product is in general waste skips?** Production materials may end up in the general rubbish by a number of routes. Sweepings, spillage, small surpluses, raw material left in bags or drums - all of these should be measured or estimated.

**63** **How much is sold as scrap? Do you know?** Scrap merchants may collect waste free of charge on the basis that they can reprocess and sell the materials to cover transport costs. Since neither party has an incentive to record the quantity shipped, materials may be leaving site unrecorded.


**64** **Calibrate your dipsticks.** Dipsticks are a widespread and inaccurate measurement technique. In one example, dipstick errors were leading to 8% too little water being added to a product. The consequent cost giveaway was significant.

**65** **How much is going down the drain?** Any process where water is used for washing will lose materials to drain. If these are treated on-site then the quantity of material in the effluent can be estimated from the chemical oxygen demand/biochemical oxygen demand (COD/BOD) of the discharge. If not, then the water company's bills may contain COD or BOD estimates.

**66** **How much is digested by bugs in the treatment plant?** Effluent which is treated biologically on-site 'loses' mass in the digestion process. The sludge from the digester consists of dead bugs whose dry mass ranges from 10% to 50% of the waste dry mass. In other words, up to 90% of the waste mass disappears in treatment. Feeding bugs can be an expensive business so don't give them more than you need to.

**67** **How much is going up the chimney?** If high temperatures or volatile organic compounds (VOCs) are involved, then so are chimney losses. Many substances have volatile components which are driven off by heat and disappear up the chimney. Water and solvents are the obvious ones, lost in cooking and drying processes.

**68** **How much is in dust collectors or scrubbers?** Dust particles created during cutting or grinding operations may disappear from waste collection records into general waste streams or effluent treatment without being measured.

# Waste and materials management

## Waste management

**69** **Re-use old drums for waste.** In most paint and chemical plants there is a plentiful supply of empty raw material drums to use for waste containers. But even in plants where this possibility for re-use is recognised you may still see new drums used for waste, usually for want of a system of supplying empty raw material drums to the areas that need them - the waste generating departments.

**70** **A plastic liner costs a tenth as much as a new can or drum.** Plastic liners can be used to line cans and drums for carrying waste materials (such as filters and rags) to disposal points. The drum may then be re-used.

**71** **Segregate to reduce costs.** Cross-contamination of waste streams can be a big problem if it leads to waste being disposed of at a higher cost than necessary. In one plant, liquid wastes mixed with solids prevented efficient disposal of either. Similarly, some automated systems in printing plants mix white and printed waste, reducing the resale value by 70%.

Keep waste streams separate at source and combine them only in controlled and cost-effective ways such as diluting non-pumpable high viscosity material with waste solvents to enable disposal as low viscosity waste.

**72** **Use coloured bins for collecting different materials.** In aluminium foundries, the use of different coloured metal bins for collecting swarf and scrap made from different alloys is common. The alloy can be remelted and used again for casting.

Colour-coded bins are an effective way to segregate waste and materials for recycling at source and could be applied in many industries.

73 **Realise the sales value of all metal-containing waste.** Metal-bodied items such as cartridge filters should be segregated from other waste for sale as scrap metal. It's much easier to segregate waste at the point of production than to sort it afterwards.

## Recycling and re-use

74 **Manage overmake for recovery.** What can be done with part batches left at the end of a production run? Keeping such production 'tails' for re-use can be a logistical nightmare! If you can't sell the extra to the customer, give them the overmake gratis - at least you save yourself the cost of disposal.

If this is not possible, create a proper stock registration system for the tails and analyse production to provide clear guidelines about repetitive products. Try to rework them immediately.

75 **Pump/filter contents and tank washings can be recovered.** In paint-making, once a good system is set up for recovering surpluses there is an opportunity to recover a further 5 - 20 kg of product per batch and reduce pump washing solvent usage at the same time.

Pass a defined quantity of formulation solvent through the pump/filter assembly into the tail and recover otherwise lost product for use in the dilution of the next batch.

76 **Formulate for disposal or recycling.** Avoiding the problem of obsolescence should start at the earliest possible stage - when formulating new products. Ideally, each new product will be formulated to be compatible with a 'bin' product which can consume compatible material.

77 **Obsolete material is a profit opportunity.** Most paint companies are faced with disposing of 1 - 2% of their output as obsolete material which cannot be recovered back into production. One international company set up a subsidiary which worked its way through the waste pile, reformulating it into new products. Not only did the company eliminate the disposal problem and cover its costs, it also made a sizeable profit.

78 **Establish FIFO stock rotation for finished product.** Poor stock rotation can lead to waste through product becoming out-of-date. A first-in-first-out (FIFO) system allows the product to be dealt with in age order to minimise out-of-life stock.

## Specifying and ordering materials

**79** **Don’t over-order materials.** There is a common tendency in the make-to-order environment to order more materials than required for the job - even after allowing the standard amount for waste. The caution is justified where waste is high and variable but better control of waste levels permits lower stock wastage as well.

For example, when 26 000 m of paper are needed, it would be better to order four 6 500 m reels rather than five standard 6 000 m reels. Check out what reel diameter can be handled and try to get your supplier to be more flexible.


**80** **Choose units of purchase carefully.** One machining company purchased aluminium slugs by weight. Since the slugs varied in weight, up to 2 kg of additional material could not be used and were machined off. It proved better to buy by quantity to a close weight tolerance. Another example involved packaging film bought by weight but used by length. The delivered film was 10% over thickness, resulting in a 10% length loss.

**81** **Purchase powders in pellets or Big Bags.** Purchasing raw materials in pellet form reduces extraction losses and the residue left in the bag after emptying. Purchasing in Big Bags is not only cheaper, but also means there is less powder left behind after dispensing.

# Materials handling

## Receiving materials

**82** **Check containers for transit damage.** Containers may get damaged in transit before receipt. Do a spot check on the next consignment and alert your supplier to any damage you find. It is in both your interests to eliminate the causes of damages.

**83** **Don't do your suppliers' quality checks for them.** Carry out supplier quality audits instead. Getting suppliers to reduce and eliminate rejects is better, easier and cheaper than having to inspect and test all purchases.

**84** **Make sure you get good measure from your suppliers.** Most deliveries come into factories and plants over a weighbridge. For bulk liquid and solid materials it is worthwhile monitoring delivered weight against invoices. This enables you to control the effectiveness of unloading as well as the accuracy of your suppliers' loading.

**85** **Sample weighing.** For multiple deliveries and packaged products, weigh a sample. Checks can reveal suppliers' packing to be out of control. This has quality implications for formulations made up as a number of containers.

## Storage of materials

**86** **Store more liquids in bulk - without investing in new tanks.** Over a period of time, material requirements change but buying and stocking policy often doesn't. This can result in slow-moving liquid materials occupying bulk tank capacity, while higher-volume items are bought in drums.

To see if there is a problem, list liquid materials in order of consumption and compare the ten fastest-moving drummed products with the ten slowest-moving bulk products. The saving could be £90/tonne plus the wasted drum residues, without necessarily requiring investment in more tanks!

**87** **Use large mobile containers, not drums, for internal movements of liquids.** The additional cost of packaging an intermediate product into drums rather than bulk containers can be considerable. Drum residues are also up to five times greater. In one paint plant, the potential saving identified was £100 000/year.

**88** **Re-use drums internally.** Used drums may not be acceptable for shipping product to customers but may be perfectly adequate for internal use, such as for intermediates. This is a considerably cheaper option than buying new ones.

**89** **Store reels wound in the right direction.** Paper reels need to be delivered to machines oriented in the unwind direction. Marking the direction on the reels helps reduce storage and handling damage by reducing turning operations.

## Dispensing and issuing materials

**90** **Empty all bags and containers properly.** Often it is a matter of providing the right equipment, such as shaking equipment for bags. Weigh a sample of empty containers, then estimate how many are used in a year. In one large paint plant, 200 tonnes of liquid raw materials were left in containers each year at a cost of £150 000!

**91** **Drum heaters help drain high viscosity materials.** Many factories have warm rooms for pre-heating high viscosity materials. These are often not ideal, being located at a distance from production. Individual drum heaters in the production area are a good solution to this problem for small quantities. Trials show some 2 - 5 kg of materials may be left per unheated drum.

**92** **Make recipe quantities sensible multiples of material units.** One recipe called for 14.65 bags of an ingredient. How often do you suppose it was actually 14.65 bags that got added to the mix?


**93** **Remove packaging carefully.** Opening packages badly can be a significant source of material loss. Packaging needs to be appropriate for the intended method of use and unpacking procedures need to be as well defined as any other part of the operation.

**94** **Ensure similar but incompatible materials cannot be mixed up.** Colour-coding, tags or special storage locations can all be used where there is a risk of similar but incompatible materials becoming mixed up.

## Transfer and handling losses

**95** **Tank wagon cleaning may cause filling errors.** Tank wagons are often cleaned on the move with a little solvent or water. If this is not drained before the wagon goes across the weighbridge you will end up giving away or contaminating product. It does happen.

**96** **Tank wagon pipework.** Pay attention to the external pipework on the wagon between the connection point and the valve. This part fills with product, which may drain to waste when the connection is broken. Solutions to this problem are filling from above (this is the best solution), or fitting additional valves at the connection point.

**97** **Check transfer lines for spillage points.** Product conveyors tend to spill product at bends and switchover points. Survey these and weigh the waste generated at each point per shift. Then do something about them!

**98** **Fork-lift trucks can cause a lot of damage.** Fork-lift trucks can do considerable damage by accidental collisions, as well as in the course of handling. Ensure they are fitted with the most appropriate handling equipment (such as plates or rubber-tipped tines). Store materials clear of fork-lift truck access routes and train operators to keep damage to the minimum.

**99** **Pigs or gas?** Product can be recovered cheaply and effectively from pipework before cleaning by using pigs or by purging with an appropriate gas. Pigging is a simple and cheap technique that can prevent product build-up in pipework and reduce waste.

**100** **To pump or to drain, that is the question.** Geometry permitting, gravity transfer is much preferable to pumping for transfer of liquid materials. Pumped transfer creates waste when material is left in the uphill section of the pipe.

Material adhering to pipes and tanks can often be recovered by rinsing through with a compatible solvent.

**101** **Flexible connections are often too long.** Flexible pipework is often wastefully longer than necessary. A typical 25 mm internal diameter flexible hose can contain 3 kg of product for every 5 m when full. Why use a 5 m tube when 2 m would do? The saving could be 2 kg per use.

**102** **Mobiles can be emptied properly, closed tanks can't.** Trials have shown that more of the batch can be recovered from a mobile tank, using the proper tools, than from a closed tank. Being able to bring the batch to the machine (whether mill or filling machine) is also a plus in terms of pipework and cleaning.

**103** **Dedicated piping runs pay back.** Common tubing is the bane of the plant engineer; cleaning is required each time the product is changed, with corresponding time, solvent and waste costs. The additional investment for dedicated piping to, say, a filling head, can pay back manyfold.

**104** **Recover remains in totes returning from clients.** Some products (eg mastics and other high viscosity products) can be recovered from client-returned containers using some dilution solvent as a pre-wash and can then be re-used in production.

**105** **Pallets don't come back.** Pallets sent out to customers may come back less often than you think! In one example, the cost of pallets was being charged to production on the basis of five re-uses - the real number of re-uses was just over one! New pallets can cost up to £10 each - most damaged pallets can be repaired much more cheaply.

# Process control and management

## Process capability

**106** **Use SPC on inputs.** Statistical Process Control (SPC) is often used at the output stage of a process to tell whether the process is operating in control. Experience shows that SPC is much more valuable when used to control the inputs to a process, as a means of reducing process variation. In a snack manufacturing process, waste was high and variable because the moisture content of the flour was variable. Using SPC to control water addition rates reduced waste levels dramatically.

**107** **Sick process syndrome.** Do any of your processes exhibit these 'barely in control' characteristics of a sick process?

- High and variable waste rates.
- Search for technical fixes.

- Taking control away from operators.
- Lots of different theories about the cause of the problem.
- Denial of problems.
- A history of failed attempts to improve control.
- The process considered an art rather than a science.

If so, improvements in your understanding of how to control the process will pay dividends. Use SPC and Taguchi or other experimental designs to understand cause and effect, reduce variability of inputs and improve control. (See Tips 106 and 52/53.)

**108** **What is your process capability?** A basic requirement of low-waste production is always to operate within your process capability. But first of all you must know what your capability really is!

A process is capable when its normal variation is within the tolerance required. The process capability index $C_{pk}$ is six times the standard deviation of the process divided by the tolerance range. If $C_{pk}$ is less than 1, the process is capable. $C_{pk}$ above 1 indicates an incapable process resulting in waste or rework.

**109** **Over-correction, 'hunting' and learned helplessness - SPC is the answer.** The main problem in controlling many processes is that they have their own 'normal' variation. Reacting to every deviation may lead to over-correcting the process, causing 'hunting' and instability. On the other hand, the normal variation in the process may hide underlying changes in process conditions. If these are not detected then variability will be even greater.

SPC will help to tell you when the process is operating in control and when it needs adjusting.

## Process management

**110** **Is it reasonable to do it that way?** Inappropriate equipment can mean that operators are asked to work to unattainable levels of precision. A classic example of this is working below minimum accurate weight on a balance, or to grams on a balance calibrated in kilograms. In such cases, cover the inaccurate part of the scale so it can't be used and provide alternative balances appropriate for lower weight ranges.

**111** **Shutdown check sheets prevent start-up problems.** Check sheets are like a pilot's pre-flight checks but they can be used at shutdown or during operation as well as at set-up. Shutdown check sheets can be particularly useful as they help ensure that a process is left clean and ready to be restarted and that maintenance is attended to before, not after, the next start-up - reducing start-up waste.

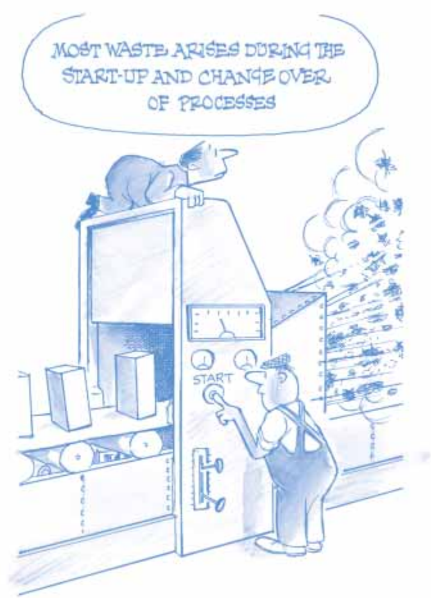
**112** **Visual examples for visual standards.** Where quality inspection includes testing a product to a visual standard, provide examples or photographs of acceptable and unacceptable product and check that the standard is being adhered to. Without proper visual standards, inspectors will reject acceptable minor faults. More importantly, you should provide the same visual standards to the people making the product.

**113** **If it isn't working don't use it!** Example: a balance doesn't quite read zero when checked but maintenance can't get to it until tomorrow and those drums need filling now. In this climate, accuracy becomes relegated to second place and is often compromised. To be able to produce accurately and consistently, conditions need to be created so that compromises don't have to be made. For example, train the operators how to adjust balances accurately for themselves. Make sure calibration checks are done regularly.

**114** **Preventive maintenance reduces unplanned stoppages/waste.** Unplanned stoppages due to breakdowns can be a significant contributor to waste. Proper planned maintenance can save materials and improve productive running time.

## Start-up and changeover waste

**115** **Right first time is the goal.** Getting a process to work right first time, every time, is the low-waste goal. Right first time is the key to rapid changeovers, flexibility and good service at low cost.



**116** **Centring of reels on a machine.** Centre a new reel of material on a spare spindle before the old one has run out. This reduces run-up time and off-centre waste.

**117** **Record previous settings.** In one injection moulding factory the control systems would provide a printout of machine settings but these were not correlated to which product was running, or whether it was running well or badly. A manual filing system soon had the machines running consistently well.

**118** **Provide setting tools.** A biscuit line was producing packs of four different lengths; however, measuring the dispensing cylinder to set the pack size was difficult. It is much easier and more repeatable to provide steel setting blanks of the right length.

**119** **SMED means low waste and rapid changeover.** When more preparation can be done off-machine then downtime and waste are reduced. A car manufacturer's pursuit of Single Minute Exchange of Die (SMED) increased performance on its auto panel presses. Many of these techniques are applicable to all sorts of other processes. There is a book by Shigeo Shingo who developed these ideas: *Revolution in Manufacturing (Single Minute Exchange of Die)* (Productivity Press, USA).

**120** **Stop-start operation causes waste.** Each start-up after a meal-break stoppage leads to waste. Staggering meal-breaks is one way to make running more continuous and less wasteful. Discontinuous feeds to a continuous process can also lead to stoppages and be a source of waste. Automate feeds such as pallet changers to eliminate such stoppages.

## Reducing process losses - industry examples

### Casting

**121** **Maximise metal yield.** This will help to minimise the amount of recycling in a foundry. Good ratios lead to a lower melt volume, reducing energy costs. In aluminium casting, each re-melt creates a yield loss in the form of oxide which must be removed to prevent weakness in the casting.

*Sand casting*

**122** **Minimise sand use.** Reduce sand-to-liquid metal ratios by:

- Using shaped boxes that follow casting contours more closely.
- Blocking-in box corners (where appropriate) to reduce the amount of sand required to fill a box.
- The judicious use of 'loose pieces' and inserts to hollow out the mould in non-critical areas.

- Reviewing wall thickness and, in particular, the amount of sand beneath the casting. The use of reinforcing wires or bars may be preferable to excessively thick walls.
- Incorporating lumps of waste sand as a backing material to fill space and reduce binder consumption. An alternative is to use metal spheres cast with metal which would normally be pigged. These spheres must, however, be confined to sand away from pattern face.

123 **Control sand mixing.** Waste sand is the most significant waste from many foundries. Control sand mixing by ensuring that mixer types/ capacities equate with mixed sand demand. Train the operators.

124 **Reduce waste sand.** Maximise reclamation using primary and secondary techniques. Maximise the proportion of reclaimed sand in the sand mix and ensure the hopper capacity is sufficient.

*Die casting*

125 **Control casting variability.** How variable is cast weight? If it is significant then the chances are you are overpouring to avoid underweights. Reducing variability will allow you to improve quality and reduce average fill, thus improving metal yield.

126 **Standardise die design.** If several dies are in use for the same design, then measure the metal yield for each. It is a good bet that you will find that one is significantly better than the others; standardise on this one for any future dies.

## Machining

127 **Machining is inherently wasteful.** Removing material from a solid block by machining is flexible but very wasteful. Casting, sintering, pressing and forming are all lower waste alternatives which should be seriously considered.

128 **Use minimum stock blank size.** If machining is unavoidable, use the smallest amount of stock possible. You will probably reduce tool wear and breakdown frequency as well as waste.

129 **Segregate swarf by type for recovery.** Swarf machined from stock containing additives is often saleable at a higher value if segregated from the remainder. Avoid contamination of alloy swarf with other metals as this contamination reduces its scrap value.

130 **What's hiding in the bushes?** Wear in bushes can lead to machining errors and frequent changing of tools which are not at fault. Check what's lurking in the bushes!

**131** **Tool set-up blocks minimise changeover time.** When changing from one part to another, have all the necessary tools set up in a specially made tool block. This will minimise changeover time and start-up waste.

## Metal processing

**132** **Nest components to optimise blanking from sheet or strip materials.** Nesting different components on the same sheet is an effective way to reduce waste of sheet materials. Nest stock components with specials to minimise offcuts.

**133** **Optimise cutting from length.** When a range of lengths is to be cut from stock lengths, it pays to optimise length utilisation and to stock and manage offcuts to minimise waste. In drawing operations, excess length may be produced by inaccurate cutting or diameter control, leading to length waste.

**134** **Control ancillary materials.** In metal fabrication, ancillary materials such as paint and packaging materials are often free-issue or poorly controlled. Losses may be significant and costly.

**135** **Plating thickness control.** Check the weight gain of components. This should be measured and controlled to minimise giveaway of plating materials.

**136** **Control of rinsing water.** Rinse water in plating and anodising operations can often be recycled for pre-wash, or it can be concentrated by ambient evaporation to allow re-use in the plating tank.

## Assembly

**137** **Accuracy of BOM is vital.** In assembly operations, Bill-of-Materials (BOM) accuracy is essential, not only for ordering and process efficiency but also for minimising waste. BOM inaccuracy can lead to rejects, component imbalance, shortages and rework.

**138** **BOM versions change.** Managing BOM version changes well is the key to minimum waste and cost. The main waste problem is obsolete components or sub-assemblies. Manage these to run them out before changing to the new version.

**139** **Control of rejects from assembly.** Rejects from assembly need to be well controlled to ensure all the good parts are reworked back into production. Care is needed to avoid excess inventory caused by completing the production run before reprocessing the rejects.

**140** **Overmake/undermake.** When assembling variants to order, control of run length is important to avoid overmake or undermake and consequent obsolescence. Control assembly by managing input of base components to the line and managing in-line inventory and rejects well.

## Plastic moulding

**141** **Multi-component moulding.** When one part is moulded around another of a different colour, separation for recycling becomes impractical. This requires a shift in thinking towards minimising start-up and reject levels. Balancing supply of components is also crucial since both shortages and overmake of the insert cause waste.

**142** **Handling of offcuts in plastics processing.** Care is needed to set up collection and recycling systems for plastics materials which are processed by cutting or moulding after extrusion. Incorporation of regrind may be limited by process factors, and offcuts to component ratios need to be designed to work within these limits.

**143** **Regrind in injection moulding.** In injection moulding, care is again needed in handling rejects. The problem is often cross-contamination of colours or different materials, which can lead to excess materials that cannot be recycled. Of course, reducing rejects at source is the best option.

**144** **Design of sprues and runners in injection moulding.** Sprues and runners should ideally be minimised to reduce re-melting costs, and should be designed for recycling within the process. Sprue systems which are removed downstream can be recycled but this is more difficult to manage due to the delay and distance involved, especially where colours must be segregated for re-use.

It is now common to design hot-runner systems which leave no sprue but this must be thought of at the component design stage and not left to the mould design stage. It is all part of designing for low-waste production.

## Food industry

**145** **Striving to avoid contamination can increase waste.** Small amounts of contamination in blending processes are inevitable. Striving to eliminate contamination can lead to unnecessary waste. A food company purged a line of 700 kg of a high-cost oil at each changeover, believing that the oil was contaminated with a different oil. In fact, the line contained only 3 - 4 kg of the 'contaminant' which was causing no problem whatsoever. Cancelling the purge saved £100 000/year!

**146** **Alternative ingredients may cost more.** Mixing and blending operations often permit use of alternative ingredients depending on availability. In one food blending operation, high production material cost variances were traced to blending operators having no guidelines on the cost implications of the variations they were happily concocting.

**147** **Line pigging.** In one factory, pigging filling lines recovered 12 kg of syrup from a short, self-draining line on every batch change. This saved £4 000/year.

**148** **Sauce wars.** A short-shelf-life ready-meal factory was constantly plagued by overmake of sauces which went out of shelf-life and were dumped. The cause was a war of words between cooks and technologists which was only resolved when an amnesty was declared so that the cooks could expose the actual working practices and actual yields on sauces.

**149** **Give them back the keys.** In some cases, managers will lock process control panels and take away the keys rather than trust the operators to control the process. If an adjustment is necessary, the operator needs to be trained and able to make it.

**150** **Things don't 'just fall off' conveyors.** Poor conveyor design, maintenance and loading systems *allow* things to fall off.

**151** **Water is not free - and hot water is even less free.** Monitor washing use of hot water and determine if the second 50% increases or decreases your hygiene security margins.

**152** **Do you use any 'cheap' materials which do not require control?** The losses of these 'cheap' materials, such as water, may take with them losses of energy and other materials. Improved control of water usage may save more than just the water costs.

## Chemicals, paint and ink

**153** **Keep tanks covered to minimise evaporation.** Covering tanks is common practice but it must be done well to be effective. In a series of trials conducted in a plant in Europe it was demonstrated that a cover which leaves only 1% of the surface area of a tank exposed is still ineffective in preventing evaporation of solvents. Plastic covers kept on with elastic are the best option. In one celebrated case, bicycle inner tubes were found to be the perfect size!

**154** **Switch off extraction when it's not needed.** Extraction is often necessary for safety reasons, and to protect operators and the internal environment of the factory. Extraction from tanks containing solvent-based products such as paint is needed during dispensing of powders and during agitation. At other times it only serves to increase evaporation losses. So, switch off extraction and stirring when not strictly necessary.

**155** **Keep agitation time of paint tanks to a minimum.** Agitation puts energy into the tank, increasing temperature and hence evaporation. Constant agitation results in considerable losses. Agitation should be reduced to a minimum consistent with avoiding separation. In one case, reducing agitation to 30 minutes per shift reduced solvent losses with no effect on quality.

**156** **Samples are part of yield loss.** Add up all the samples and you may get as high as 10 kg per batch or 0.25%. Review the need for them and consider reducing their size as well as their number.

**157** **Dilute to the middle of the solids range.** Solids content, the expensive part of most paints and inks, is often given away to customers by under-diluting in the final stages. Adding a little more solvent at the dilution stage may help to increase output by 0.5 - 1% at marginal cost.

**158** **One-way valves can prevent fallback of materials.** Suction pipes are often used for lifting liquids from drums. Where the pump is higher than the drum, liquid will inevitably fall back into the drum from the pipe, with a loss of up to 1 - 2 kg per operation. A one-way valve will prevent the fallback; the liquid in the tube can be recovered by lifting the pipe higher than the pump.

**159** **Reduce the number of transfers per batch.** In paint and ink production, batch size is often less than finished batch size, since large batches are often made out of several small mill bases, each of which may use several tanks. Reducing the number of mobiles used per batch reduces yield losses and dirty solvent generation.

**160** **Milling waste is valuable waste.** A kilogram of product wasted at the milling stage can be worth twice as much as a kilogram wasted at filling. That's why milling departments are often a fruitful hunting ground for wastebusters!

**161** **Check intermediate process yields.** Many chemical processes are multi-stage reactions. Ensure consistency of yield and batch sizes *throughout* the process. This can significantly improve downstream efficiency and consistency, and reduce waste significantly.

**162** **Reduce solvent waste in cleaning mills.** Trials have shown that the best way to clean a mill is to wash out at the end of milling with at least three system-volumes of batch solvent, passing it into the batch. This leaves the mill clean enough to require a pre-wash of only one system-volume. More of the solvent and product ends up in the batch and less in the waste.

**163** **Why purge pumps?** Pump purge is the product wasted because operators can't risk contamination. Suggestions for circumventing this problem include: dedicate pumps to compatible ranges of product; to avoid colour contamination, clean pumps promptly and properly and leave dry; purge a minimum into a separate container and throw away only if contamination is visible.

## Printing

**164** **Analyse how ink waste arises.** Ink is often wasted in printing because an excess is mixed for a bespoke job. Thus, you have the choice of saving it - just in case, saving it for rework in another colour, or disposing of it. The pressure to dispose comes from concerns over quality, lack of storage space and inadequate rework systems. Study carefully how the overmake arises. Get advice from your ink supplier on optimising ink usage. Consider modern blending systems.

**165** **Study estimation methods.** This applies to both ink and substrate. Always make certain that your estimating procedure has a feedback loop which enables you to compare estimate with actual. Over-estimation causes waste, while under-estimation causes shortages. Without feedback, 'overs' allowances tend naturally to increase.

**166** **Minimise corrections.** Inaccurate make-up of ink leads to corrections. Corrections lead to bigger batches. Bigger batches lead to surpluses. Surpluses lead to waste!

**167** **Drawdown can be a source of inaccuracy during colour matching.** Where colour computer systems appear not to work, start by checking the drawdown preparation. To make a good drawdown you need consistent substrate, consistent draw bars, clean drawbars, unworn drawbars, well-maintained K coaters, well-trained operators and the correct master against which to check.

**168** **Ink bases can also vary.** Only when drawdowns and colour measurement are found and proven to be perfect is it worth checking the ink bases to ensure that these are of constant shade and strength. Discuss the systems and variability with your ink supplier. Most suppliers now provide specialist assistance, often including on-site support. The ink system used can have many implications, not least for the containers used for delivery - and for who cleans them.

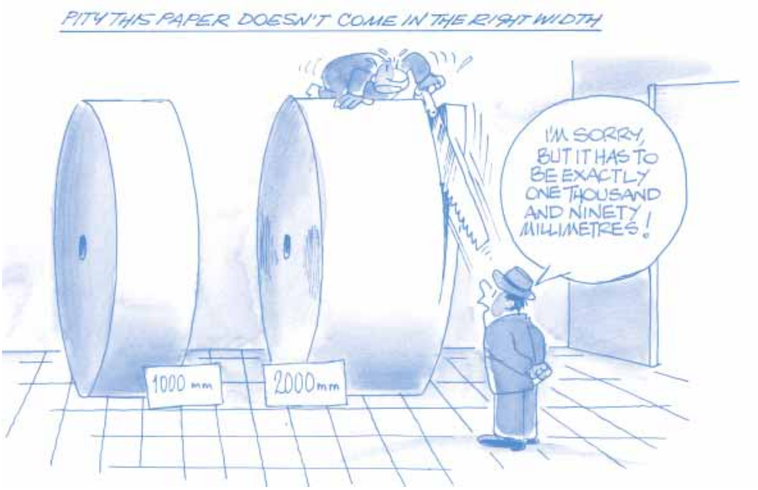
**169** **Keep press conditions constant.** Ink will perform consistently only under constant press conditions and these should be recorded and repeated. Press condition and maintenance can be critical in ensuring consistency.

**170** **Tray waste can be significant.** Ink waste is often designed into the presses - especially when the presses are running small batches. Just filling the system can cause a large surplus of ink which may or may not be re-used. Check all your pipe diameters, tray sizes, and pump and tank sizes to engineer this potential waste out of the system. Modern ink systems are designed to minimise these surpluses.

**171** **Don't make waste disposal of valuable ink too easy.** Easy, uncontrolled disposal routes for excess ink is an invitation to dump. Lock the access point and control dumping. Check out cleaning procedures and materials.

## Paper processing and converting

**172** **Pity this paper doesn't come in the right width...** To reduce changeovers and stocking requirements, paper companies often standardise on a limited range of web widths. Review carefully whether these are the most appropriate for the range of cut sizes required. You may be able to reduce the amount of trim.




**173** **Ensure sheet counters are accurate with periodic checks.** Sheet counters are not always accurate. In fact, they are often set to count out a few extra sheets for safety. Periodic checks can identify the problem early and allow corrective action, reducing giveaway.

**174** **Don't stop the process to splice.** Using flying splices keeps the product in specification and wastes less material than stopping for a manual splice. The technology also exists to do manual splices without stopping the process.

**175** **Lamination is a juggling act.** A splice in any layer of a laminate creates a fault. Careful juggling of infeed reel sizes reduces faults and increases good continuous length by matching splicing positions in different layers.

**176** **Collation.** In the collating process, each reel change causes waste of other parts. To minimise stoppages operators may replace a part reel as well as the one which is exhausted. Standardising reel lengths means that all parts are changed together, minimising stoppages and waste.

**177** **Roller alignment.** Good alignment of transfer rollers is essential in all web-fed machinery. Ensure alignment is checked accurately and regularly.

**178** **Run cores down to the minimum.** The risk of breaking the web may lead to caution in running reel cores out. An inch of paper left on the core can be 1% of the reel. Repeat this at each of three or four processes and there can be 3 - 4% losses from this cause. Maintain or replace brakes, introduce better speed control and introduce operator graphing of core waste.

**179** **Run reels as big as possible.** Running the biggest reels possible minimises changeover waste and time. In one paper converting plant, repositioning a pipe on one machine allowed a 12% increase in reel size through the whole process!

**180** **Monitor print quality during the run.** Printing runs tend to creep upwards if not carefully controlled! The difficulty has always been quantifying the problem during the run. Operator-based monitoring of print quality has been successfully used to answer the question, 'How is the run going?' The answer can be, 'We're running 4% over allowance and we'll probably need one more reel,' or even, 'The job is going so well we can cut a couple of reels off the run'.

**181** **Plan coating mix quantities carefully.** In paper coating, calculate the quantity of coating mixture required to avoid end-of-run surplus. There should be at least three standard mix sizes and runs should be planned to end on the smallest mix. One paper converting plant applied this technique, saving £30 000/year.

**182** **Paper reels are vulnerable.** The outside surface of an unprotected paper reel is very sensitive to damage. Because the circumference is greatest at the surface of the reel, damage here has disastrous effects. A bruise penetrating 5% into the surface of a paper reel damages 10% of the paper.

**183** **Ban razor-blade knives.** For the same reason as that given in Tip 182, operators should be encouraged to slab off the minimum - razor-blade knives are definitely out! A specially designed slabbing knife with a reel protector built in minimises slabbing loss.

**184** **Good reel protection.** Rewrap reels between processes and don't use unprotected fork-lift tines to handle them. Grab lifters are good; but only if used carefully - they can cause more damage than a fork-lift!

## Cleaning losses

**185** **Use the cheapest mix.** Mixtures of solvents are often used for cleaning but prices of solvents change over time and you may be able to reduce your costs by reformulating. Set up some trials to ensure you are getting the best cleaning power per £.

**186** **Resin production can be a source of free cleaning solvent.** Solvents may be by-products of chemical reactions used to produce resins. Installing a separation tank allows recovery of the solvent fraction which is suitable for use in cleaning. One plant saved £200 000/year this way.

**187** **Meter and register wash solvent.** As you might expect, metering and registering wash solvent will reduce your consumption.

**188** **Leather cleans cleanest.** In paint production, operators do a good job scraping out mobile tanks to get the material into the batch but the best tool for the job is undoubtedly the leather-bladed scraper. Used in conjunction with a palette knife you can actually get a 1 tonne mobile clean enough so that only 5 litres of solvent are needed to clean it!

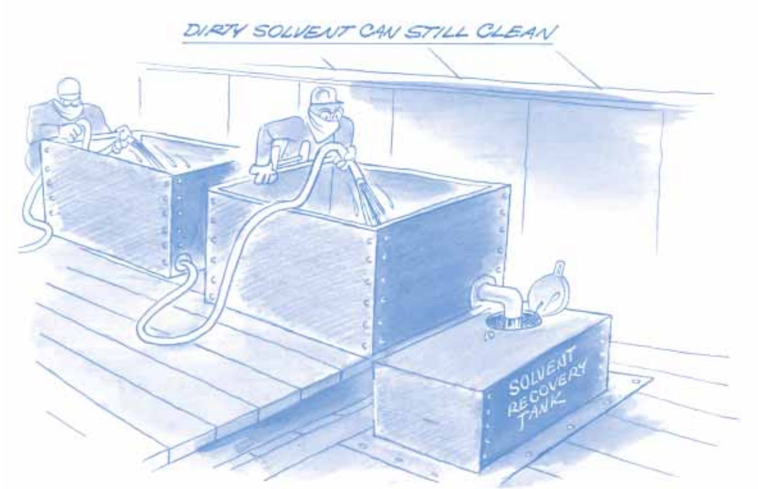
**189** **Regenerated solvent is not free.** Regenerating dirty solvent by distillation to use for cleaning is an opportunity to reduce disposal costs and solvent expense. But, remember, regenerated solvent is not free and should be controlled like any other material.

**190** **How to get the most out of installing a still.** The way to get the most benefit out of installing distillation plant is to reduce solvent consumption and establish controls first - you may well find that you don't even need the distillation plant after all!

**191** **Everyone knows the best cleaning procedures.** But do they? What about the new person starting next week, or long-standing employees who've got used to doing things their way? Once established, all cleaning procedures should be clearly documented and new employees trained in using them as part of their induction.

**192** **Use paper instead of rag for cleaning.** Paper is more absorbent than rag and hence generates less waste per kilogram of product absorbed. The saving in disposal costs may well prove to be more than the extra cost of paper.

**193** **Dirty solvent can still clean.** What looks like dirty solvent still has lots more cleaning power. In fact, solvent can still be effective for cleaning when it contains up to 15% solids, particularly if filtered effectively. Waste dirty solvent streams are typically 5 - 8% solids which means that half the cleaning power is wasted. Put another way - twice as much solvent is used as is really necessary!




**194** **Minimise rinse quantities for mobile tank cleaning.** Mobile tanks are often washed with dirty solvent and then rinsed with fresh solvent. When the tank of used solvent is full, it is emptied, even if the solvent is comparatively fresh. In fact, the relatively clean final-rinse solvent is added to the dirty solvent. The key to reducing the production of dirty solvent is to minimise the rinse.

**195** **Minimise rinse quantities for pump and filter cleaning.** The same principles as in Tip 194 apply to washing pump and filtration systems. A drum of dirty solvent can be used to pre-wash, purging with the first few litres being purged to waste. The rest can then be recirculated, and be followed by a minimum, measured, clean rinse.

## Healthcare products

**196** **What waste level is acceptable?** In a sanitary towel-making operation, the standard waste level was 5% but operators had no way to relate that to actual operation. Defining the standard in terms of kilograms of waste per shift gave a simple feedback on performance at the end of each shift.

**197** **Waste monitoring is key.** Calculating mass balance (see Tip 18) in healthcare product factories can be a nightmare since materials are bought by units, length or volume and sold in all sorts of different size packages by number. Waste is often collected in Eurobins (1 100-litre wheeled containers) and compacted without weighing. The key is to implement waste collection and weighing systems - the cost of the materials in a typical Eurobin may be £200 or more, while disposal cost may be as little as £3. Savings could be huge since waste levels can be quite high, eg 10 - 20%.

**198** **Run out waste in sterile product processing.** In sterile product processing, 15 - 20% of waste may be caused by the need to run a process clear at each stop to avoid possible non-sterile waste. To reduce this waste the process needs to be designed or operated to start and stop with minimum waste.

**199** **Packaging waste can cost more than product waste.** Healthcare products are often multi-layered and have expensive packaging. From the start-up of the packing process, waste is created until the various parts come into register with one another.

In a dressing line there was a perception that the active part of the product (an impregnated pad) should be conserved. So the practice was to get all the packaging into register first, and then start up the active ingredient. However, this actually caused more waste while the active ingredient settled down. In fact, the least-cost method in this case was found to be starting it all up together. More of the active ingredient was wasted but the packaging savings more than compensated for this.

**200** **Thread the shortest path first.** What is the best order in which to thread up a multi-part process? The standard approach of threading the item with the longest path first created extra registration waste on this part each time an additional part was added. Threading the items starting with the one with the shortest path saved materials and time.

# Conclusion

**Many of the tips given in this Guide may seem simple or obvious but that isn't the point. The real point is to stimulate you to look for opportunities to reduce waste and save money in *your* company.**

Some of the ideas presented require a more scientific approach and research into the methods which might apply in your circumstances. Some of them you will already be doing but have a check through them all. You may learn some new tricks.

The Environment and Energy Helpline on 0800 585794 can help by giving you free, up-to-date information on a wide range of environmental issues, legislation and technology. You can ask for the latest publications list of independently verified Case Studies on cost-effective techniques and technologies. Three free Good Practice Guides that you might find particularly relevant are GG25 *Saving money through waste minimisation: raw material use;* GG26 *Saving money through waste minimisation: reducing water use;* and GG27 *Saving money through waste minimisation: teams and champions.*

Companies employing fewer than 250 people can benefit from a *Fast*Track visit. These are free, confidential on-site waste reviews carried out by an independent Envirowise consultant. They are intended to identify waste minimisation opportunities on the spot and to help companies increase profits quickly. At the end of the visit, the consultant provides the company with a report on the day's findings, together with a suggested action plan. Contact the Environment and Energy Helpline or visit the *Fast*Track area of the Envirowise website.

## Other useful Envirowise publications, software and video

*Waste minimisation interactive tools* (IT96) - easy to use software to help you implement a waste minimisation programme

*Cutting costs by reducing waste: running a workshop to stimulate action* (GG106)

*Waste minimisation clubs: setting them up for success* (GG122)

*Waste minimisation pays: five business reasons for reducing waste* (GG125) - everything you need to present your case (includes presentation on disk)

*Profiting from practical waste minimisation: running a workshop to maintain the momentum* (GG174)

*Profiting from less waste* (ET206) - a leaflet about which Envirowise publications will help with each step in a waste minimisation programme

*A fresh pair of eyes: identifying waste minimisation opportunities* (video) (V217)

*Waste mapping: your route to more profit* (ET219)

*Waste account: count the cost of waste for your business and measure your savings* (ET225) - gives details of software that can be downloaded from the Envirowise website

*Profiting from reducing water use: running a workshop to stimulate action* (GG229)

*Green officiency: running a cost-effective, environmentally aware office* (GG256)

*WasteWise: increased profits at your fingertips* (IT313) - interactive CD-ROM that provides an easy-to-use resource that takes a structured but flexible approach to waste minimisation

*Cutting costs by reducing waste: a self-help guide for growing businesses* (GG38C)

# 121 Euphemisms for waste

Allowance
Batch growth
BOD
Broke
By-product
Cake
Cancelled orders
Clay loss
Cleavage loss
COD
Compactor load
Contaminated solids
Contract cake
Conveyor loss
Core loss
Cracking down
Credits
Cullet
Customer returns
Damage
Deckle loss
Defects
Dents
Deposit loss
Dipstick error
Dirty solvent
Doubles
Downgrade
Drainings
Dregs
Dross
Dumped
Dust
Edge trim
Effluent
Evaporation
Excess stock
Extraction
Factory shop
Flash
Furnace loss
Garbage
Giveaway
Greenhouse loss
Hidden losses
Inspection loss
Invisible loss
Joins
Leakage
Make-ready
Make-ups
Material variance
Moyle
Non-conforming material
Obsolete stock
Offcuts
Out-of-shelf life
Out of spec
Overcount
Overdelivery
Overfill
Overissue
Over-production
Overspec
Overweight
Packaging
Pig food
Pitcher
Potato ratio
Process loss
Purge
Reaction loss
Recoverable loss
Reel ends
Reel strippings
Regrind
Rejects
Residue
Resort
Returns
Rework
Rubbish
Runners
Samples
Scrap
Second quality
Seconds
Selvedge
Shop loss
Shortages
Shrinkage
Side run
Slabbing off
Slag
Slow-moving stock
Sludge
Smiling pies
Spangling
Spare mix
Sprues
Still bottoms
Stock loss
Stone
Substandard
Surplus
Swarf
Sweepings
Tails
Trash
Trials
Turn of scale
Underdelivery
Unrecoverable loss
Uplift
Usage allowance
Usage variance
Washings
Web break
Work in progress variance
Workaway
Yield loss

# The stairway to zero waste - a self-assessment guide

As you read through this appendix consider whether you agree with the statements at the start of each step. This will help you decide the starting point for your waste minimisation strategy. You may also find that different people in your organisation believe you are at different points.

## Start - Waste is not an issue

Waste is not an important issue facing my company .................... *True/False*

There is no manager or director responsible for waste ................ *True/False*

Waste is not discussed at board or management meetings .......... *True/False*

Waste does not cost us very much ............................................ *True/False*

If any of these is true then you do not consider waste to be important. You might like to note that most companies in the UK have moved on from this position because of regulation and increasing waste disposal costs.

If you stay here your competitors may be reducing their costs by waste minimisation and, by becoming more competitive, they may threaten your market position.

## Step 1 - Waste is only a disposal issue

Our main concern is waste disposal costs .................................. *True/False*

Our concern is finding the easiest method of disposal ................ *True/False*

These are proper concerns but if these are your only concerns about waste then you are on Step 1. Waste is a low priority, because the full costs are not appreciated. The concern about disposal costs is valid but may miss the point - waste costs are much higher than just disposal costs. Try a full waste cost analysis.

## *Step 2 - Waste is a cost and regulatory issue*

Compliance with regulations is board level responsibility............. *True/False*

We know all the likely effects of waste regulation ...................... *True/False*

We know the full cost of waste ................................................ *True/False*

Waste costs my company.................................... £_____________ per year

If all these are true then waste is becoming an issue for you. Your waste cost evaluation includes waste treatment and disposal costs, raw materials and product lost in the waste streams, energy, waste handling costs, loss of output or capacity, and labour cost for processing waste.

The next stage is to go beyond compliance with regulations and identify some savings from waste minimisation.

## *Step 3 - We plan to reduce waste*

We know all the main sources of waste and their costs ...............*True/False*

We have set target reductions for each source............................ *True/False*

We will move beyond compliance to waste minimisation............ *True/False*

We plan to save .............................................. £_____________ per year

You are starting to make progress. Putting costs to sources will focus attention on the need to improve efficiency in specific areas and setting targets will provide the necessary motivation. Management is committed to waste reduction and resources are made available for this purpose.

## *Step 4 - We have identified our waste and are monitoring it*

Waste is monitored as % production or % costs ........................ *True/False*

Waste performance is tracked over time ..................................... *True/False*

Waste information is communicated regularly............................. *True/False*

It's an old adage that if you don't measure it, you can't manage it. Quantifying and controlling waste are essential at this stage to monitor progress against target and to improve waste awareness by communicating waste information at all levels in the company.

Housekeeping will improve and ideas will be generated by the workforce once management attention is focused on the issue of waste.

## *Step 5 - Waste is coming down as we change the way we work*

Some of the best ideas come from the workforce........................ *True/False*

We are modifying processes and procedures to reduce waste...... *True/False*

We have cross-functional teams working to reduce waste ........... *True/False*

At this stage your processes are becoming more efficient, releasing materials, labour and capacity for additional output or cost reduction. Waste performance will be improving, reducing emissions to the environment. Improvements will feed back to improve motivation. As success is achieved, more challenging targets start to seem feasible.

## *Step 6 - We are optimising our processes and achieving big cost reductions*

We now understand our processes from trial and experiments .... *True/False*

We use Statistical Process Control (SPC)
to improve process control ...................................................... *True/False*

We are looking at all stages of the process ................................ *True/False*

At this stage, big cost reductions come in as the depth of understanding increases. Communications improve as it becomes evident that a major source of waste is at the interface between business processes. Over-ordering or imbalances in production are eliminated.

The connections between process improvements, waste reductions and cost reductions become clear and the logic of the drive towards zero waste becomes evident.

## *Step 7 - Only a change in technology would eliminate waste completely*

All source reduction opportunities have been implemented ......... *True/False*

All processes have been studied and improvements made ........... *True/False*

Further waste reduction would require changes in technology..... *True/False*

Well done! Your waste is minimised with your current technology. You will have reaped substantial cost benefits by this stage and have waste well under control, preventing pollution.

Moving to the final stage may require substantial change in products or processes. Replacing process technology happens in cycles as markets and technology develop. Judging when to make the change is an important strategic decision. If you plan in the zero waste objective you will start the next cycle with a cost and control advantage over the competition. In the meantime, keep up the pressure on waste minimisation.

## *Step 8 - Zero waste*

We have re-engineered our process to eliminate waste................ *True/False*

Congratulations! Few companies reach zero waste but the most efficient get very close. Over a number of business cycles the best companies will keep ahead by getting closer and closer to zero waste. Making the best use of resources and minimising your impact on the environment makes sound business sense.

Envirowise - Practical Environmental Advice for Business - is a Government programme that offers free, independent and practical advice to UK businesses to reduce waste at source and increase profits. It is managed by AEA Technology Environment and NPL Management Limited.

Envirowise offers a range of free services including:

- Free advice from Envirowise experts through the Environment and Energy Helpline.
- A variety of publications that provide up-to-date information on waste minimisation issues, methods and successes.
- Free, on-site waste reviews from Envirowise consultants, called *Fast*Track visits, that help businesses identify and realise savings.
- Guidance on Waste Minimisation Clubs across the UK that provide a chance for local companies to meet regularly and share best practices in waste minimisation.
- Best practice seminars and practical workshops that offer an ideal way to examine waste minimisation issues and discuss opportunities and methodologies.

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***For further information please contact the***

**Environment and Energy Helpline**
**0800 585794**