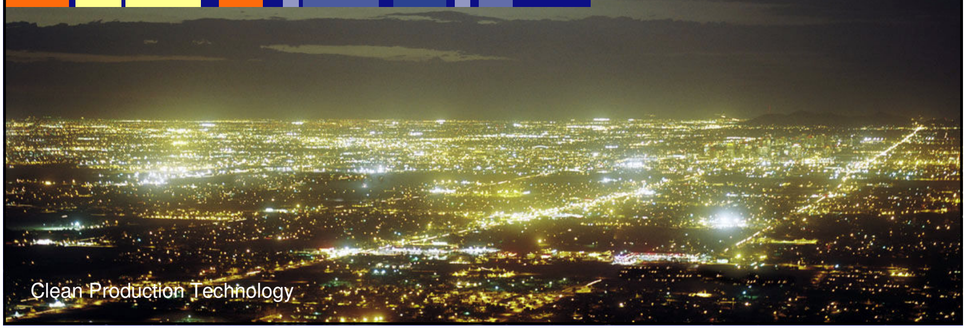
Clean production technology

From good housekeeping to process optimization

TNO | Knowledge for business



Content of the presentation

- What is Clean Production Technology
- The way to do it : the Method
- Good housekeeping
- Process control
- Monitoring and targeting
- Case 1: Example monitoring and process optimization
  Water reduction on rotational screen printer
- Method for process optimization
- Tool: Cause analysis
- Case 2: Theory for optimization open width washing machine and
- practical advices

Clean production technology

Deals with:

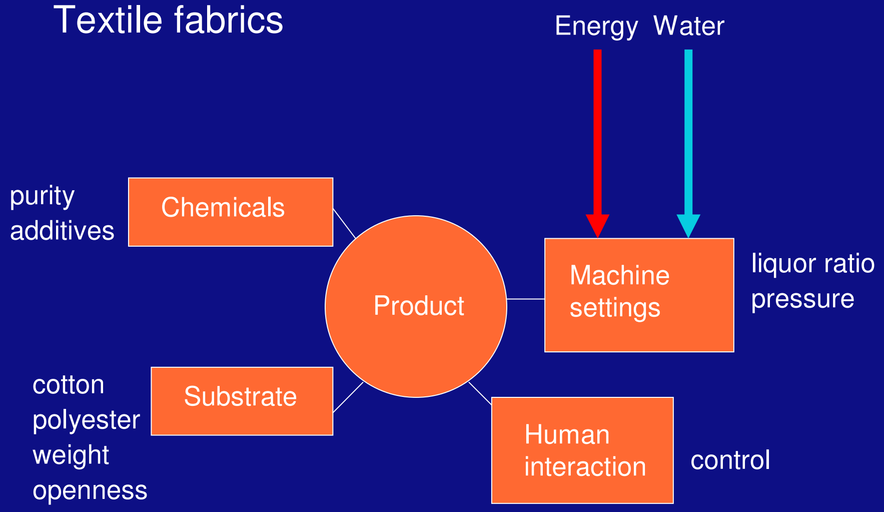
reduction of materials
- chemicals,
- water
- energy and

working condition related items like
- noise and
- odor

Cleaner Production: a pro-active approach,

"Prevention is better than cure"

Textile fabrics



Energy management

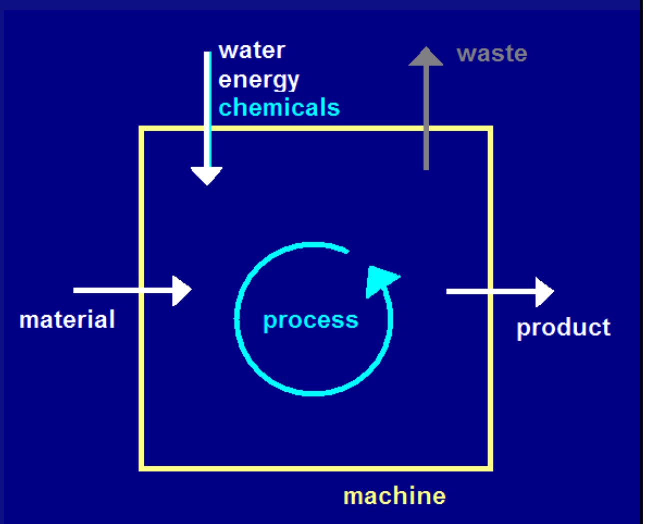
- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimisation

- Getting started
- Analysing the process steps
- Generating opportunities
- Selecting solutions
- Implementing solutions
- Sustaining Cleaner Production

The method

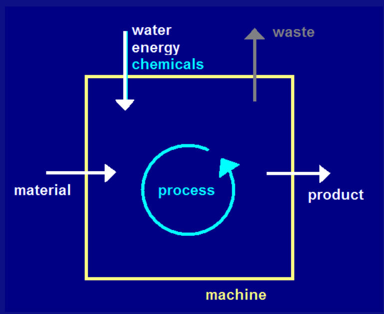
Recognize opportunities to save:

- chemicals
- water and
- energy.



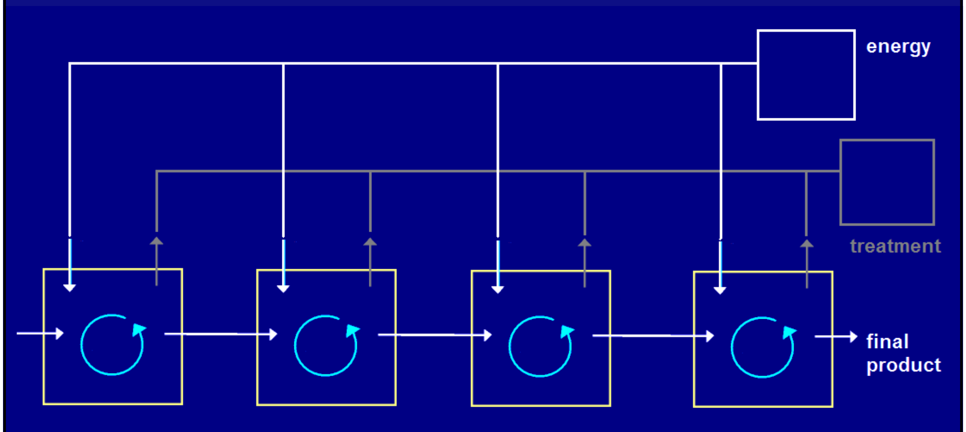
The method

- Chemicals
- Water
- Energy



- Analyse
- Avoid
- Control
- Optimise
- Re-use

Factory wide view



Energy

Shapes:
- Wood
- Natural gas
- Furnace oil
- Electricity
- Steam
- Thermal oil
- Compressed air

Users:
- Boiler
- Motors (fans)
- Air conditioning
- Compressors
- Lighting

For every entity we can ask ourselves:

- What is it?
  (What are the essential parts? How does it relate to other parts?)
- How does it work?
  (Theory, State of the art, Alternatives)
- How can I control it?
  (What goes in , what comes out?.
  What are the quality constraints for these flows?)
- How can I improve it?
  (Increase, Decrease, Eliminate, Exchange, Add)

End-of-pipe technologies

technical solutions dealing with treatment and disposal

CP → *reduction or elimination of end-of-pipe technologies.*

Implications / Benefits

Demand from
- government
- customers

→

Result
- increase in production and
- a better relationship with your clients
- new market opportunities ('green' products)

Effort
- installation of measuring devices,
- time for collecting data and analysis,
- formulating optimization
- implementation
- the training of personnel

→

Savings
- chemicals,
- energy and
- water as well as on
- the reduction of over-treatments and
- the reduction of off-spec products

How?

More

- attitudes,
- approaches
- work organization and
- management

than

- technology.

Sharing information on how to tackle problems

The way to do it : the Method

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization
- Recycling

- Getting started
- Analysing the process steps
- Generating opportunities
- Selecting solutions
- Implementing solutions
- Sustaining

- on-site recovery or re-use
- creation of a useful by-product

Management commitment

- Secure it!

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

Good housekeeping:

"be critical about the plants behaviour"

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

Guidelines Good Housekeeping (1):

- Work neatly
- Keep walls, floors and furnishing clean (standards of tidiness)
- Aisles and passages should be clean at all times
- Dispose waste in a proper way
  (packaging, metal bands, nails, wood, yarn, fabric, dust etc.)
- Keep hygiene standards (toilets, washing facilities, smoking)
- Avoid spilling, when it happens, sweep up spillages immediately

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

Guidelines Good Housekeeping (2):

- Use good equipment
- Reduce obvious emissions
- Cover reaction tanks
- Clear operating instructions
- Prevent overflow by sufficient drainage
- Make preparations to handle unusual occurrences

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

Good housekeeping measures

- substantial cost savings without significant investments
- duration of implementation is often very short
- better control of a certain process leads to better control of the quality of the product

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

In textile industry we deal with complicated production method with many process parameters!

- water flow
- electricity
- m^3 natural gas
- steam
- temperature

- fabric speed
- fabric weight
- width
- pH
- colour

Make an inventory of what is measured in the processes

What will it bring if we collect more data?

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

Process control leads to better defined quality

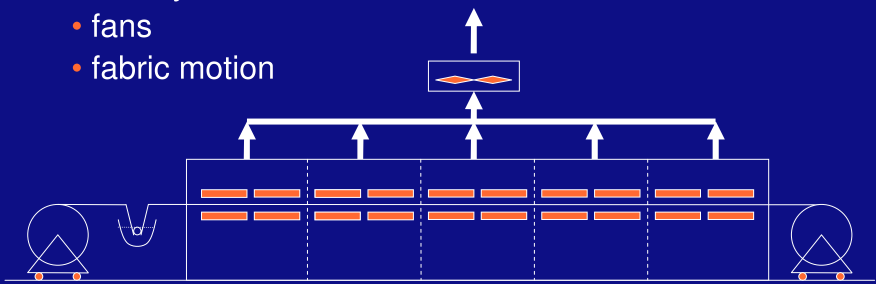
- Identify process parameters
- Measure process parameters
- Control process parameters

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

Stenter

Energy consumption stenter

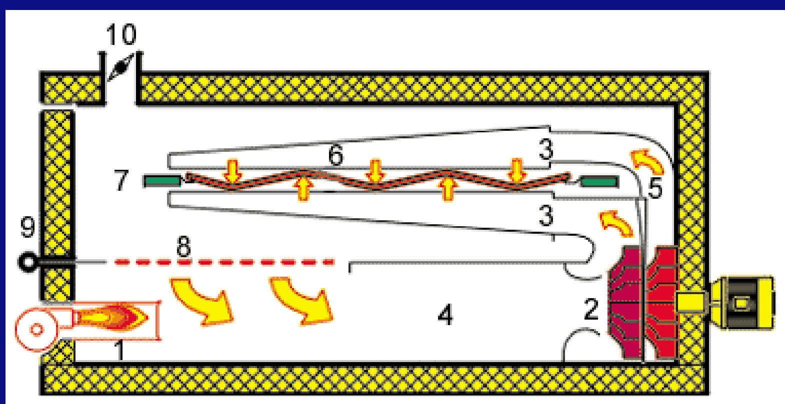
- Gas:
  - heating air
  - moisture evaporation
  - losses (radiation)
- Electricity:
  - fans
  - fabric motion



Stenter

6 fabric
1 burner
2 circulation fan
10 exhaust valve

Individual chamber



Stenter

Used for:
- heat-setting
- drying
- thermosol processes
- finishing

Options:
- optimising exhaust airflow
- heat recovery
- insulation
- heating systems
- burner technology
- nozzle and air guidance systems

Stenter

Process parameters:
- moisture content
  - exhaust air
  - fabric

Control parameters:
- speed
- temperature
- refreshment of air

Understanding of
- drying
- curing

Identify controls and process parameters

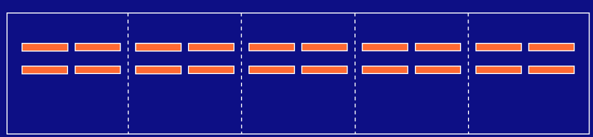
- Exhaust valve
- Exhaust fan
- Circulation fan

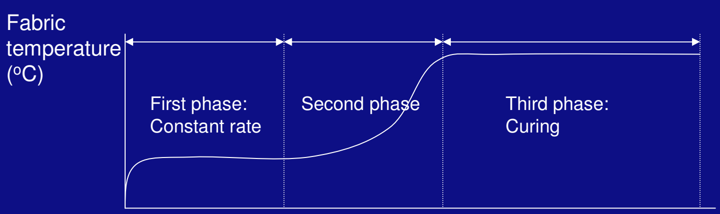
- Moisture content of exhaust air
- Temperature of chambers
- Temperature of fabric
- Speed of fabric

What is measured, what should be measured?

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

Three phases





Required temperature profile during drying

Process control by

- exhaust valve/fan
- moisture content of exhaust air
- NOT in the first place BY SPEED of fabric!

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

What is monitoring?

- measure: consumption of: water, electricity and gas

  production (per kg, meter, square meter)

- calculate consumption per production

  example: water/kg or water/m^2, electricity/kg, m^3 gas/kg

- compare with target values

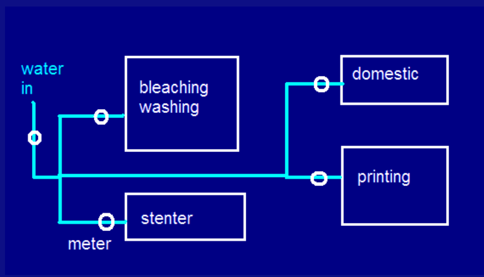
Energy management: translate into actions ....

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

Monitoring on plant level:

Make water balance

- Identify consumers/major machines in factory
- Find a practical division of the plant
  - machines
  - departments
  - buildings
- Distribute consumption over these parts
- Do the same for energy (electricity, gas, steam)



- Management commitment (motivation)
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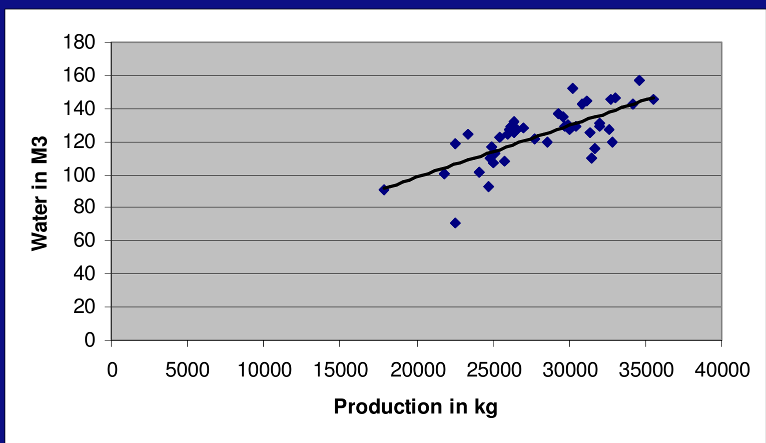
Analysis water consumption



Monitoring on machine level:

Product related monitoring

- Distinguish the products the machine makes
- Identify product groups if necessary (products with more or less identical consumption)
- Calculate consumption per production

Consumption can depend on the nature of a product

- width
- weight
- material
- process steps
- production route

Sources:
- annual report
- logistic
- planning system
- cost calculation
- administration

Start simple but do start!

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

What is the result ?

- insight in consumption per process or per product
- quick feedback when deviations occur
- support for decision making
  (where to investment time and money)
- motivation of personnel
- report for management and third parties
- benchmarking (compare with other plants)

Enlarge insight and get grip on processes

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

- Management commitment (motivation)
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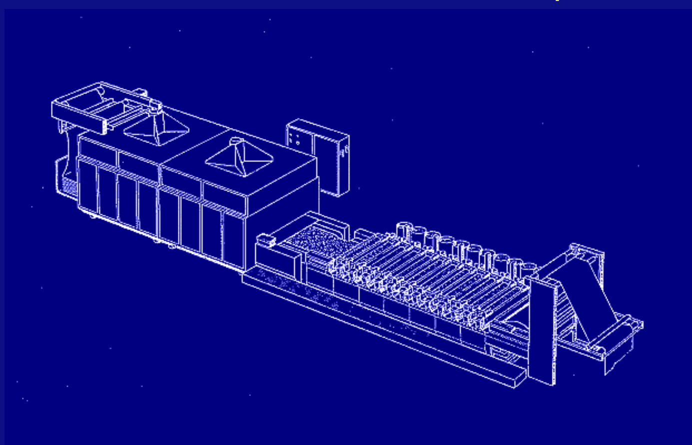
- Getting started
- Analysing the process steps
- Generating opportunities
- Selecting solutions
- Implementing solutions
- Sustaining Cleaner Production

To be dealt with in a moment,

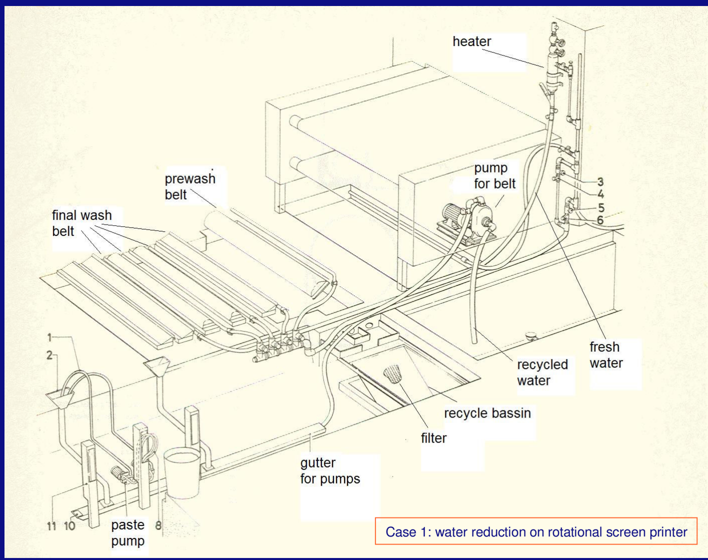
But first….

Case 1: Monitoring and process optimization

Water reduction on rotational screen printer



Washing installation on RDIV



Case 1: water reduction on rotational screen printer

Washing around a rotational printing machine (Stork RDIV)

Identification of washing processes

- washing belt
- rinsing pumps
- washing squeegees
- washing screens
- different taps

Figures as reference

Consumer	Stork manual RDIV	
belt	13-25	[l/min]
pump	17-167	[l/min]
pump	0.75	[m^3/color]
squeegee	35	[l/color]
screen	45	[l/color]
taps	?	[l/min]

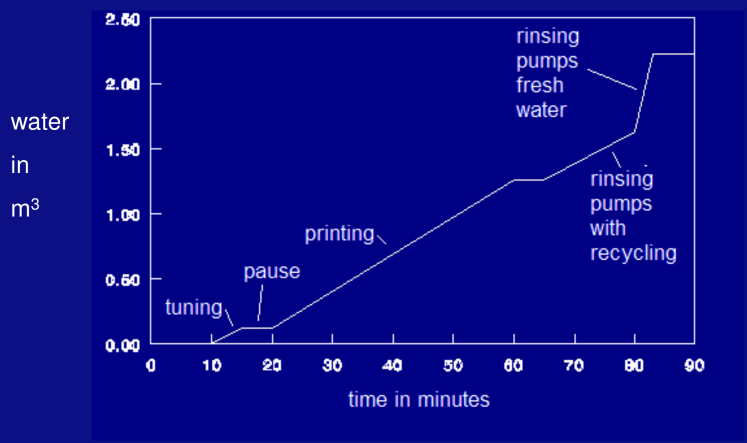
← With or without recycling

← First and second wash cycle

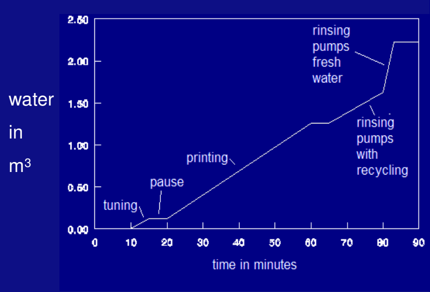
Conclusion

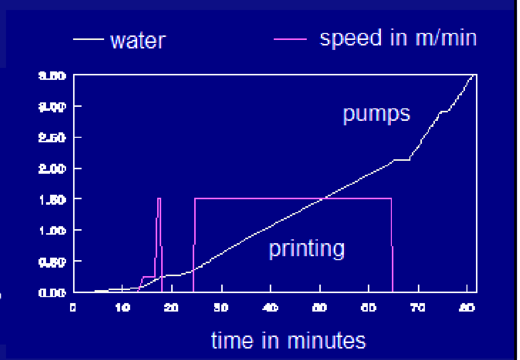
- Water consumption is between 7 and 16.5 m^3 per hour
- Comparable with open width washing range!

Water use RDIV per batch according Stork



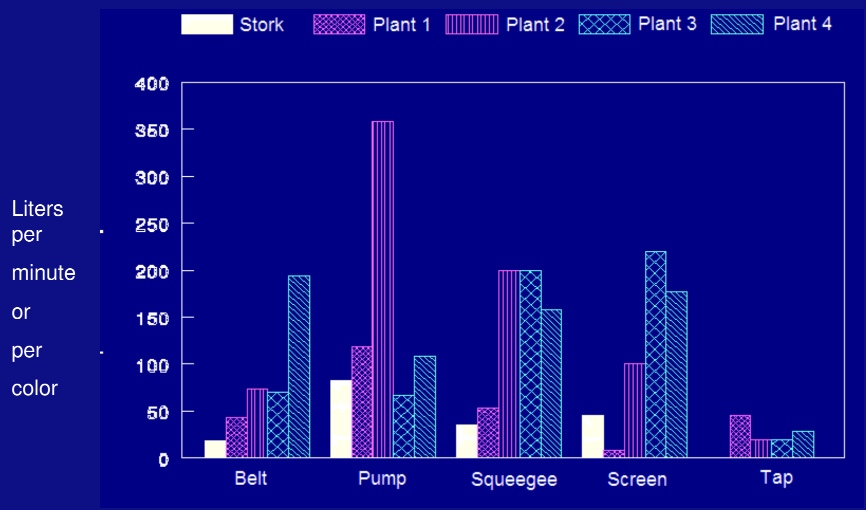
Compare reference and practice





Reference Practice

Comparison practice in four different plants



General recommendations

- install water meters at big consumers
- do active maintenance: inspect and update washing processes for:
  - color kitchen,
  - belt washer,
  - pipes and pumps,
  - squeegee washer,
  - screen washer and
  - taps.
- list the water consumption of each
- investigate reuse on other machines (for instance water for washing squeegees can be used for rinsing pipes and pumps)
- hot water washes better than cold water. Investigate means of preheating water.

Recommendations printing machine

- optimize water flows,
- reactivate (if applicable) re-use of water (water basin),
- prevent additional waste in basin and clean if necessary,
- clean filters on a regular basis,
- make water flow dependent on production speed,
- set water consumption belt washer according to glue used on belt,
- refresh water in gutter for pumps according to number of pumps in action,
- use smaller squeegees,
- use paste recycle system,

Recommendations screens

- re-use water,
- use timers so washing time is independent of work,
- wash according to number of screens,
- use sensors to locate positions in use,
- spray width should be dependent of width screens,

Recommendations squeegees

- inspect washing cycle (movement of nozzles, time),
- leave room to interrupt manually,
- wash according to number of squeegees in washer,
- keep cycle short (bottleneck for changes),

Recommendations Taps

- consumption of taps (20 to 40 liter per minute) can be neglected in comparison with others users
- ensure enough pressure for rinsing manually,

Case 1: water reduction on rotational screen printer

Getting started

Form a Cleaner Production team

- management
- engineer
- operator

- possible backup: external expert/consultant

- Management commitment (motivation)
- Good housekeeping
- Monitoring and targeting (on process level)
- Process optimization

↓

- Getting started
- Analysing the process steps
- Generating opportunities
- Selecting solutions
- Implementing solutions
- Sustaining Cleaner Production

Review
process parameters and measurements
of the selected process

Generate opportunities (ideas for improvement)

Obvious some Cleaner Production opportunities
should be implemented immediately
without waiting for detailed feasibility analysis
(such as repairing the leakages).

- Getting started
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Cause analysis

Technical causes
Poor housekeeping:
Leaking taps, valves or flanges
Spillages
Overflowing tanks

Tool: cause analysis
- technical causes
- operational and maintenance negligence
- poor raw material quality
- poor lay-out
- bad technology
- management causes
- employee de-motivation

Operational and maintenance negligence
Worn out machines
Unchecked water and air consumption;
Unnecessary running of equipment
Sub optimal loading and dosing
Lack of preventive maintenance
Adoption of avoidable process steps
Operation because of habits

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Cause analysis

Tool: cause analysis
- technical causes
- operational and maintenance negligence
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Poor raw material quality
Use of substandard cheap raw material
Lack of quality specification
Shortages of supply
Improper purchase management system
Wrong material selection
Improper storage
Poor process or equipment design
Mismatched capacity of equipment
Lack of information or design capacibility

Poor lay-out
Unplanned/ad hoc expansion
Poor space utilisation plan
Bad material movement plan

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Cause analysis

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Bad technology
Continuing with the same technology
despite product/raw material change
High cost of better technology
Lack of availability of trained manpower
Lack of information

Management causes
Increased dependence on casual or contract labour
Lack of formalised training system
Lack of training facilities
Job insecurity
Fear of losing trade secrets
Lack of availability of personnel
Under-staffing hence work over pressure

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Cause analysis

Tool: cause analysis
- technical causes
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Employee de-motivation

Lack of recognition

Absence of reward/punishment system

Emphasis only on production, not on people

Lack of commitment and attention by top management

- Getting started
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Selecting solutions

- Getting started
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feasibility depends on
- The availability of new machines and materials;
- The presence or absence of technical skill and manpower;
- The space for new machines;
- Maintenance of new machines and material;
- Quality of production and product when using other methods;
- Shut down period for implementation;
- The flexibility of the production process.

Make technical, economical and environmental assessment.
Most attractive one is solution with best benefits (prioritize)

Implementing solutions

- implementing CP solutions is similar to any other industrial modification

- Getting started
- Analysing the process steps
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- Sustaining Cleaner Production

Sustaining Cleaner Production

- implementation job is only considered to be complete sustained when stable performance has been measured over a reasonable length of time

- Getting started
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List of Best Available Techniques

- Most effective and advanced
  practical suitability of particular techniques with
    - acceptable emission limit or
    - reduce emissions

- Best
  - most effective in achieving a high general level of protection of the environment as a whole.
- Available
  - realistic scale under economically and technically viable conditions,
  - considering
  - costs and
  - advantages,
  - accessible.
- Technique
  - technology used and
  - designed, built, maintained, operated and decommissioned.