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**Maintenance &
Plant Reliability**

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- Maintenance and factory reliability are important cost and plant performance parameters
- Reliability should especially ensure maximization of plant utilization at high efficiency
- Key performance indicators for different factories should be briefly discussed
- 140 Billion Euro were spent in Germany on maintenance (2008/2009) of industrial plants
- Typical maintenance cost range: 2 – 5 % annually of original investment cost (Europe 30 – 50 US\$/t sugar)
- Proper maintenance procedures and maintenance documentation

1. Materials with longer wear life e.g. stainless steel. Total cost analysis for material and labour
2. Selection/prioritizing of maintenance areas
3. Replacement of equipment having a high maintenance requirement (e.g. change from mills do diffuser and reduce maintenance by ~ 50 %) but also concerning pumps, couplings, bearings, etc.
4. Productivity increase of maintenance work force
 - Elimination of manual tasks by mechanical equipment, e.g. chain winch replaced with electric overhead travelling crane
5. Modern management methods to properly plan and co-ordinate all maintenance activities

Personnel skills

- Identification with plant and responsibility! -> take ownership
- Teamwork
- Maintenance with own manpower or outsourcing?

Software tools

- SAP control (intervals, cost control, ...)

Logistics / spares / suppliers

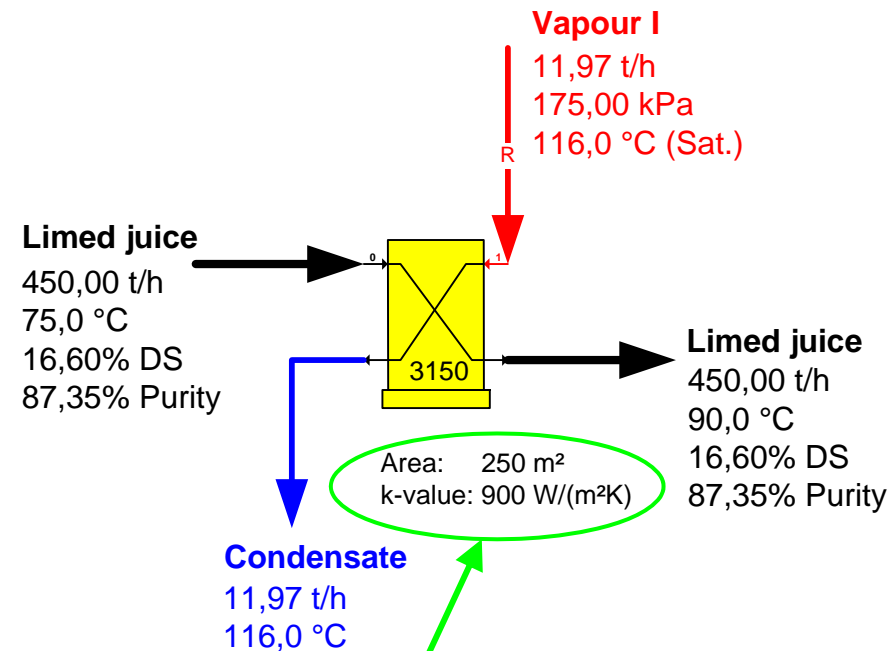
- Central spare register
- Strategic spares
- Preferred suppliers (e.g. pumps, centrifugals, valves,...)

Advanced Monitoring System (AMS)

- **Software tool** processing data of the PDAS & Laboratory system
-> complementary link between **condition and performance monitoring**
- Based on **standard, industry accepted and proven software**
 - SugarsTM: Process modelling software
 - Visio[®]: Process visualization software
- **On-line mass- energy and colour balance**
- Approx. **100 - 150 input variables** are necessary compared to up to 3000 values recorded by the processing system and in the laboratory

- Consistent mass- and energy balance of the process -> **transparent factory**

Example: Heater



- **Equipment performance** is directly shown

Key performance indicators

	Pakistan Mill				
Factory rated crushing capacity	11,000 tcd				
Actual capacity divided by theoretical capacity	87 %				
Season length	120 - 140 days				
What percentage of production equipment is covered by preventive maintenance?	10 %				

	Pakistan Mill				
What percentage of preventive maintenance was developed:					
<ul style="list-style-type: none"> using a formal analytical methodology 					
<ul style="list-style-type: none"> just using „good practise“ or „local experience“ etc. 	good practice/ local experience				
Hours scheduled/preventive maintenance work:					
<ul style="list-style-type: none"> in-season 	5-10				
<ul style="list-style-type: none"> during off-season periods 					

	Pakistan Mill				
Hours planned for unscheduled maintenance work in-season (i.e. breakdown hours)	40				
Total number of people employed in maintenance (excluding contractors)	280				
Number of full-time maintenance Technicians on site (excluding contractors)	200				
Number of maintenance Planners/Schedulers	25				

	Pakistan Mill				
Number of full-time graduate Engineers on site	10				
Number of first-line maintenance Supervisors (or ratio Supervisors: Technicians)	200/10=20				
Cost of annual maintenance – split out as:					
• routine preventive work	450,000 US\$				
• unscheduled (breakdown) work	150,000 US\$				

	Pakistan Mill				
• major (e.g. annual) refurbishment work	200,000 US\$				
Number of third party maintenance contracts	8				
Cost of third party maintenance contracts	300,000 US\$				
Man-hours of third party contract maintenance work	not available				
Types of Condition Monitoring technology utilised in the factory's routine maintenance activities	very low				

	Pakistan Mill				
Condition Monitoring activities outsourced to third party contractors	balancing of centrifugal machines, fibrizer & fans				
Replacement asset value (RAV) of the production equipment	not available				
Number of M&R line items in the engineering stores	5,000 numbers				
Number of critical spares held in store (line items)	200 numbers				
Total values of M&R spares held in store	700,000 US\$				
Specific maintenance cost (US\$/t sugar)					

*Thank you for
your attention!*

