

Priteesh Mahajan
ABB Ltd
Hiren Joshi
Hiecon Technologies



Innovations in VFD Applications – the Indian Context



Contents

- Modern AC Drives & Machines
- The Textile Industry
- Dry Process – VFD Applications
 - Case Study – The Ring Frame
- Wet Process – VFD Applications

Modern AC Drives & Machine Structure

- Decentralization of Intelligence into Industrial Drive Modules
- Sectionalisation of machinery
- Increased performance in smaller and simpler systems
- Increased Energy savings and Environmentally compliant machines
- Elimination of components
- Increased Flexibility
- Excellent Motor Control

Decentralization of Intelligence

- Intelligence is distributed among various speed controlling drives .
- Intelligence is localised into various machinery operations
- Control Loop is closed within the variable frequency drive.
- Separate controller is not needed
 - External Controller systems are expensive
- Fast commissioning, less potential devices to get faulty
- Space and cost savings



Sectionalisation of Machinery

- Traditional systems controlled multiple functional sections of a textile machine through a single Electrical Drive – the line shaft system
- This required several mechanical modes of energy transfer.
- Increased need for energy efficient and increased productivity required that independent functions are controlled by individual drives .
- Now, One Drive for every section,
- Features like: Virtual Shaft, Virtual Gear, Virtual CamShaft,
- More of Soft control possible with better efficiency.

Machines that are better and Smaller



- Drives have opened up immense possibilities for machines with more efficient functions
- Machines can now be faster and better controlled.
- Machines will now occupy lesser space, thanks to more functionality and a smaller volume.
- Increased Functionality with reduced Complexity.
- Increased Networking capability of VFDs have made it possible to have production information at your fingertips , on your PC ,on your mobile phone!



Increased Cost savings and reduced environmental implications

- Machines are now more energy efficient and hence Variable frequency drives have made it possible to produce more consuming less.
- Increased Local intelligence in machinery sections make it modular and easy to maintain.
- Variable frequency drives have reduced the stress on the energy pool making the textile industry more safer and cleaner.

Elimination of Components

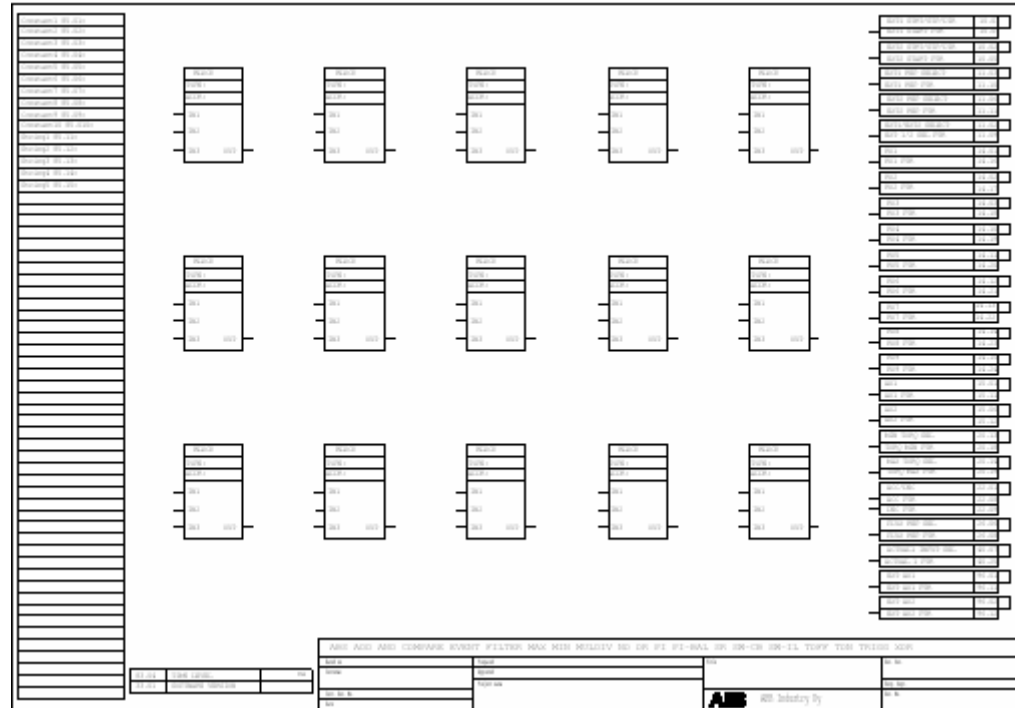
- AC Drives can eliminate mechanical components
 - Beltboxes
 - Gearmotors
 - Transmissions
 - Wound Rotor motors
 - Multi-speed motors
- AC Drives can operate with infinite speed variability
- Low or high-speed requirements made easy without speed-increasing or reduction devices
- **Benefit:** Eliminates costly maintenance and improves process control



Elimination of Components

- AC Drives can eliminate electrical components
 - Small PLC's
 - Human Interface Devices
 - Contactors
 - Motor Starters

- Benefit: Eliminates cost, number of external components and improves process control



More Flexible – Communications Options

- Wide range of communication options
- Currently available gateways

- PROFIBUS
- Modbus
- ABB CS 31
- ABB AF100
- DeviceNet
- InterBus-S
- LONWORKS®
- CANopen
- FLN
- Johnson Controls N2
- BACNet
- Ethernet



Excellent Motor Control

- New motor control techniques, Direct Torque Control, Advanced Sensorless Vector Control, .. Offer much better control
- Higher starting torque
- Better accuracy – speed and tension control
- Fast and accurate control of speed both statically and dynamically
- Excellent handling of shock loads reduces downtime

Contents

- Modern AC Drives & Machines
- **The Textile Industry**
- Dry Process – VFD Applications
 - Case Study – The Ring Frame
- Wet Process – VFD Applications

The Textile Industry

From

COTTON



To

CLOTH



The Textile Industry

- Broadly we classify this as
 - Natural Fibres (Cotton)
 - Synthetic Fibres
- Our Focus Today
 - Natural Fibres

The Textile Industry

- A Textile Mill
- Dry Process
 - Spinning and Weaving
- Wet Process
 - Processing

Contents

- Modern AC Drives & Machines
- The Textile Industry
- Dry Process – VFD Applications
 - Case Study – The Ring Frame
- Wet Process – VFD Applications

Textiles – Dry Processing



Blow Room



Carding M/c



Draw Frame



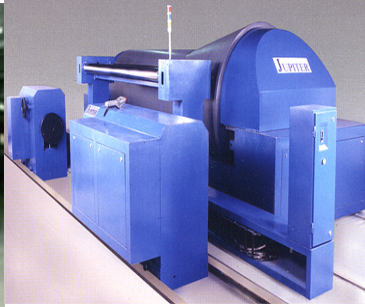
Spinning



Auto Corner



Ring Frame



Warping M/c



Sizing M/c



Loom

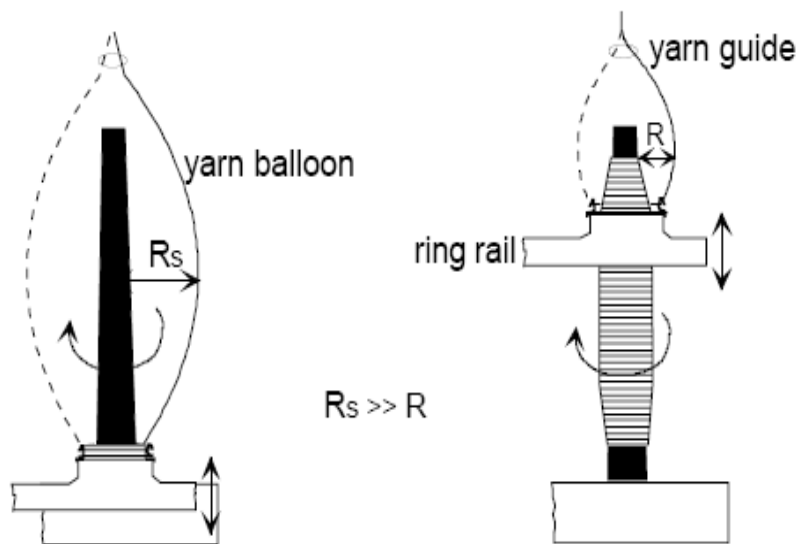
Spinning – An Indian Case Study

- The Ring Frame Machine
 - Function – Yarn Cone Winding



Spinning - Application description

TEXTILE RING FRAME M/C Tension control
WOBBULATION in Spinning Macro



Empty bobbin i.e. high tension

Built up doff i.e. low tension



$$F = M \omega^2 R$$

where

F = Force experienced by the yarn

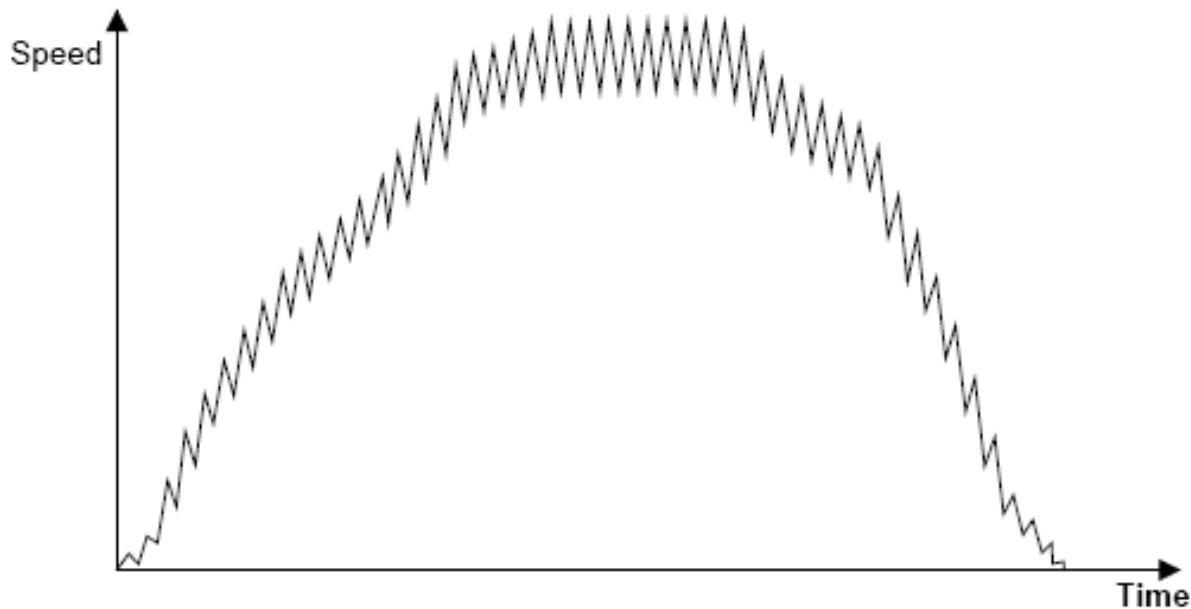
M = Mass of the yarn

ω = Spinning speed

R = Radius of the balloon

The Solution

■ TENSION CONTROL IN YARN USING Wobulation

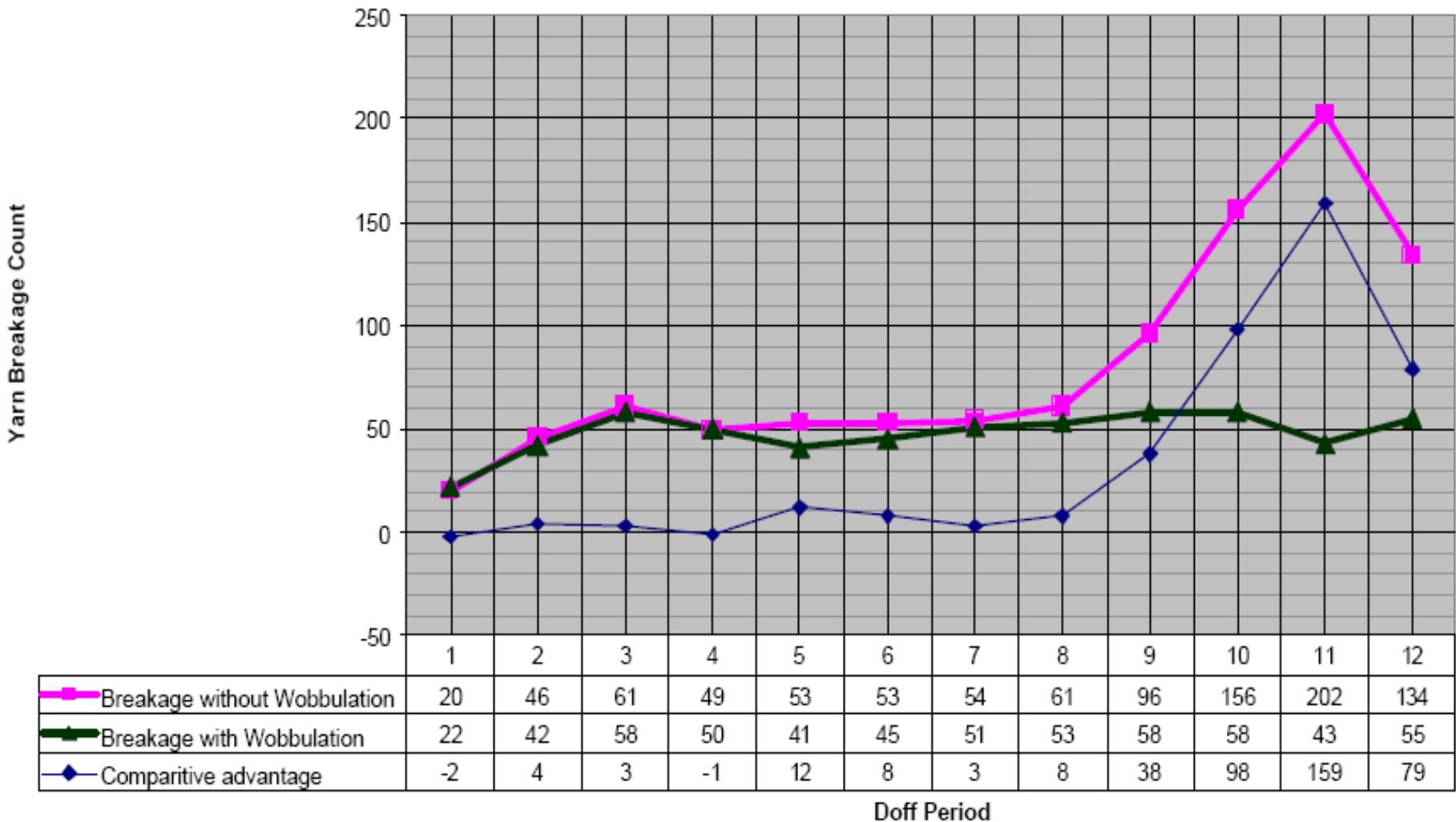


45.04: WOB SPEED UP MUL	Par.45.4	1
45.05: WOB SPEED DOWN MUL	Par.45.5	0.98
45.06: RAMP TIME WOB UP [s]	Par.45.6	14.5
45.07: RAMP TIME WOB DOWN [s]	Par.45.7	6

The Results

Breakage Count Comparison

■ Breakage without Wobulation
 ▲ Breakage with Wobulation
 ◆ Comparitive advantage



The Results

COMPARISON OF CERTAIN PARAMETERS

Parameter Name	Value without Wobulation	Value with Wobulation
Total Number of Breakages	985	576
Breakages per hour	84.43	49.37
Breakages per hour per 100spindles.	20.1	11.76
Production in hanks	11.1	11.1
Wt of Yarn per spindle	47-48 gms	48 gms
Wastage per Doff	470 gms	310 gms

Solution comparison

AC Drive with Built-in Wobulation	Centralised Solutions
Inbuilt Control of Wobulation	External PLC with suitable cycle time required
Saves Expensive Wiring	Wiring between PLC and drive calls for potential failures and cost
No communication devices required	Communication devices between PLC and Drives need to be maintained
Breakage reduction without additional investment	Breakage reduction through wobulation calls for additional Inputs and PLC programming



Contents

- Modern AC Drives & Machines
- The Textile Industry
- Dry Process – VFD Applications
 - Case Study – The Ring Frame
- Wet Process – VFD Applications

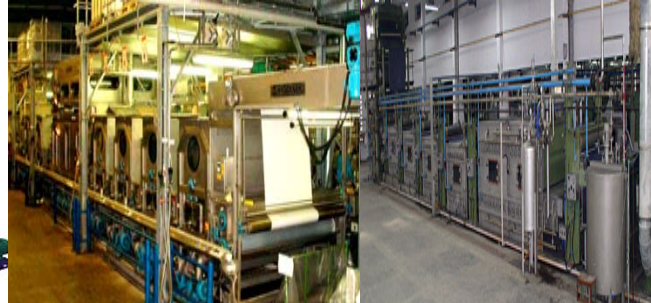
Textiles – Wet Processing



Indigo Denim



Jet Dyeing



CBR

CDR



Rotary Printing



Flatbed Printing

Merceriser



Compressive
Shrinking Range



Stenter



Drying Range



Calendar



Inspection

Processing – The Continuous Bleaching Range



Function of machine: Continuous Bleaching Range

Advantages of Automation by AC Drives

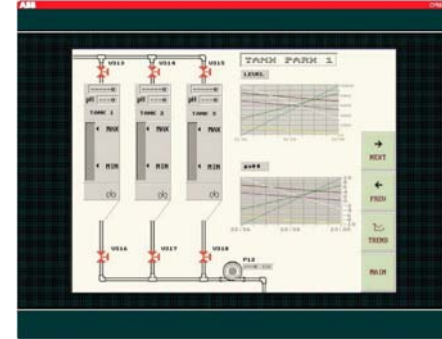
Reduce mechanical wear-tear

Increase Productivity and Quality

Accurate tension control for continuous dyeing process

Operational Flexibility

Schematic Diagram



Ethernet

RS-232C/ RS-485



Processing – Yarn Dyeing



Function of machine: Dyeing

Advantages of using AC Drives

Reduce mechanical wear-tear

Increase Productivity and Quality

Accurate tension control for continuous dyeing process

Operational Flexibility

Processing – Fabric Dyeing



Function of machine: Continuous Dyeing Range

Advantages of Automation by AC Drives

Reduce mechanical wear-tear

Increase Productivity and Quality

Accurate temperature and moisture control for continuous dyeing process

Operational Flexibility

Processing - Merceriser



Function of machine: To improve the strength & Affinity of Fabric

Advantages of Automation by AC Drives,

Reduce mechanical wear-tear

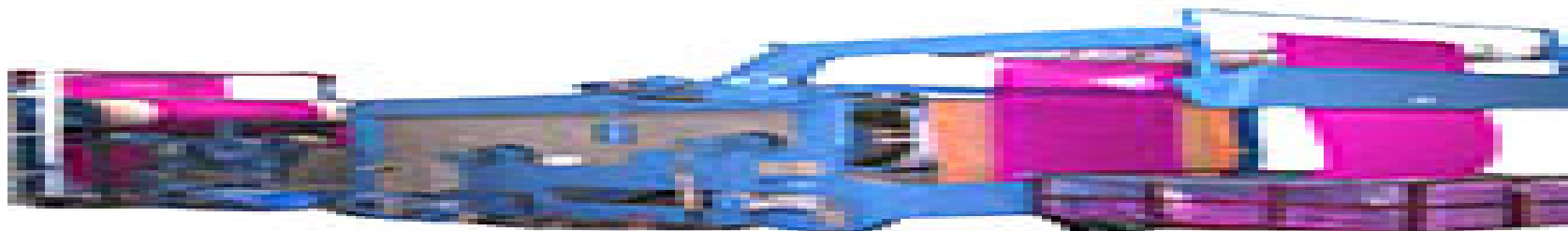
Increase Productivity and Quality

Operational Flexibility

Store the required data into the recipe function for different fabric

Accurate Temperature,PH and Moisture control

Processing - Shrinking



Compressive Shrinking Range

Function of machine: To preshrink the fabric

Advantages of Automation by AC Drives

Reduce mechanical wear-tear

Increase Productivity and Quality

Operational Flexibility

Store the required data into the recipe function for different fabric

Accurate shrinkage and moisture control

Processing - Stenter



Function of machine: Heat setting of chemical contents and drying of Fabric

Advantages of Automation by AC Drives

Reduce mechanical wear-tear

Increase Productivity and Quality

Operational Flexibility

Store the required data into the recipe function for different fabric

Accurate Temperature, shrinkage and elongation control

To Conclude

- The development challenge is - new applications for the Indian Textile Industry
 - Based on excellent products
 - Local process knowledge
- Leverage local competencies to bridge the gaps in utilisation of automation