A Laser Application on Plant Factories

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Abstract

Essential resource elements in crop production are light, water, carbon dioxide and fertilizer. Optimum design for air-conditioning and lightings in plant factory system is required to realize the economical operation of plant factory because most energy consuming elements of plant factory system are air-conditioning and lightings. In this sense, the application of solid state lighting sources such as LED in plant factory system has been promoted to expect some reduction of running cost in lighting. Since affordable laser diodes had been developed, the LED technologies developed for plant factory systems have become more useful in terms of developing advanced lighting systems for plant growth control. By looking more closely into the thylakoid reaction, it has been found that laser application on plant factories may give tremendous solutions to problems associated with lighting for the plant growth control. Research work of solid state laser application in plant factory has just started recently at Osaka Prefecture University Plant Factory Research Center.
Tsubakimoto Chain's Support for Plant Factories

Introduction to our company

The background of our approach

Problems and issues in agriculture

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of farmers</th>
<th>Average age</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>2.24M</td>
<td>64.2</td>
</tr>
<tr>
<td>2000</td>
<td>2.4M</td>
<td>62.2</td>
</tr>
<tr>
<td>1995</td>
<td>2.56M</td>
<td>59.6</td>
</tr>
</tbody>
</table>

The average age of farmers in Japan

How can we solve these problems?
Success with a plant factory in 2000
(During a second boom in plant factories in Japan)

Reason
Greater interest in food safety, food self-sufficiency rate

Cooperation with the customer
Realize the next-generation plant factory

Our approach to plant factories
Utilizing our manufacturing experience in agriculture

Experience and results in industrial products
Quantification
Optimization
Standardization

Knowledge & equipment

The field of agriculture
Low-cost, Usable
Easy to maintain
Friendly to plant production automation
Operating segments

Power Transmission Products Segment

- Chain Operations
  - Drive Chains
  - Conveyor Chains
  - Plastic Chains
  - Cableveyors

- PTUC Operations
  - Reducers
  - Clutches
  - Linear Actuators
  - Locking Devices

- Automotive Parts Operations
  - Timing Chain Drive Systems
  - General Industrial Timing Belts

Materials Handling Systems Segment

- Sorting systems
- Conveyance systems
- Multistory warehouses
- Carousel storage

Products printed in red: Products usable in plant factories

Our approach to plant factory

Core technology of Tsubaki based on results and know-how

- Systems
- Assembly Modules
- Power Equipment
- Parts

Market needs

Diversification

Providing solutions

Cultivation techniques
- Physiology of plants
- Lighting
- Environment
Our plant factory results

May 2010 – Oct. 2010

Miniature plant factory model at Shanghai Expo

Our results with plant factories

Tsubaki Technology
Used in the miniature plant factory model

Pin gear drive chain
R5® roller chain
Pin gear sprocket

Cableveyor® (Cable carrier)
Low dust generation series

Simple features

Attention on food safety

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Our results with plant factories

Mar. 2011 Osaka Prefecture University (Sakai, Osaka)
-- Center for plant factory facilities

Automated lettuce cultivation device

Large-scale automated plant cultivation system (Mar. 2011)

Cultivation tray and Tray holder

Buffering shelf (12 partitions)

Automatic conveyance device

Automatic watering station

Loading and unloading area

Automatic cultivation system by automated watering

Automatic cultivation system by circulating nutrient water
Future tasks and approaches

Problems facing automated plant factories
1) What are the real needs? (What is created by automation?)
2) What are the necessary (and unnecessary) functions?

Workers have to move to plants → Plants are conveyed to workers

Features
- Automated
- Clean

Deliver new models
Future tasks and approaches

Cultivation experiment for a next-generation plant factory

- Contributing to social welfare
- Creating new opportunities for employment

Plant-friendly conveyance
Handling plants
Reflect in design

Learn more about plant physiology and growth

Cultivation experiment
We are making efforts to help the future of agricultural production.

Thank you for your kind attention.