Platform to support plastics industries
PVC-soft applications

Jakarta, June 18th & Bangkok, June 21st 2013
Components Used in the Optimization of Your Plastic Processing System

Use of Gear Pumps in PVC soft applications & possibilities to cost reduce significantly

Speaker: Urs Gull, Director Sales
The MAAG Company

Staff: 260 (Maag Pump related)
540 (Maag Group)

Sales: 142 M Euro (Group - 2012)
86 M Euro (Pumps & Equipment)
56 M Euro (Pelletizing)

Products: Pumps (Extrusion, virgin polymer production Industrial)
Screen-changers
Large Area Filtration
Diverter valves

Homepage: www.maag.com
MPS & APM history

May 10, 2008

Management group

To support Plastics industry

March 2012

maag

platform

brands of maag

rieter

sold

maag automatik

2008

sold

maag pump systems

may 10

management

to

maag

platform

sold

maag

March 2012
Maag Pump Systems AG

• Supplier of gear pumps, screen changers, diverter valves, large area filtration
• Approx. more than 100 years in operation
• Long term experience in the polymer and compounding industry
• In house R&D, design and manufacturing under ISO 9001 & 14000 standards
• Part of the Maag Group, Headquarters in Oberglatt
• Merged with Automatik Plastics Machinery GmbH in May 2010
• Part of Dover PSG (Pump Solution Group) as of March 2012
Overview Maag Group

• continuous growth since 2005
• growth in turnover from € 87 Mio. in 2005 up to € 130 Mio. in 2011

• Turnover of € 130 Mio in 2011 further developed to est. € 142 in 2012

• over last 5 years maag group could achieve a significant growth in all applications and a
double digit growth in rubber pumps and system

• geographical expansion as well as expansion in view of the product portfolio is taken in
consideration

• As Clyde Blowers and CGS were supporting Maag’s strategy for growth, also PSG is
fostering further expansion & development

• Headquarter of Maag Pump Systems is in Oberglatt, Switzerland

• 100 years of experience in engineering and manufacturing of gear pumps and 60
years of pelletizer

• Maag group employs 540 people in 11 different locations and authorized agents in 20
other countries

• Maag group provides global service to its customers

• After Sales & service available through all maag group locations worldwide
Footprint and Locations
World class support

Manufacturing & Servicing round the world for our customers

- Frankfurt, Germany
  - Sales
  - Engineering
  - Manufacturing
  - Assembly
  - Test lab
  - After Sales service

- Villeurbanne, France
  - Sales
  - After Sales service

- Zurich, Switzerland
  - Sales
  - Engineering
  - Manufacturing
  - Assembly
  - Test lab
  - After Sales service

- Mumbai, India
  - Sales
  - After Sales service

- Moscow, Russia
  - Sales
  - Manufacturing
  - Assembly
  - Test lab
  - After Sales service

- Shanghai, China
  - Sales
  - Engineering
  - Manufacturing
  - After Sales service
  - Grinding service

- Taipei, Taiwan
  - Sales
  - After Sales service
  - Grinding service

- Sao Paulo, Brazil
  - Sales
  - After Sales service
  - Grinding service

- Kuala Lumpur, Malaysia
  - Sales
  - After Sales service
  - Grinding service

- Singapore
  - Sales
  - After Sales service

Slide 8 | Urs Gull | June 18th & June 21st, 2013
## Global Support - Centers of excellence

<table>
<thead>
<tr>
<th>Market</th>
<th>Plant</th>
<th>Pumps</th>
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- **Centre of Excellence**
- **Manufacturing Capability**
- **Assembly capability**

All plants will supply global spares for their specialised products.

---

**Centre of excellence support customers worldwide**

- **maag**
  - Pump systems
- **automatik**
  - Pelletizing systems
- **maag**
  - Filtration systems

*slide 9 I Urs Gull I June 18th & June 21st, 2013*
Maag's extended arm India: PSG India-Chennai facility

PSG Portfolio

POSITIVE DISPLACEMENT PUMPS
- RECIPROCATING
- ROTARY
- PERISTALTIC
- ALMATEC®
- BLACKMER®
- APAQUE™
- NEPTUNE™
- ENVIRONEER®
- QUATTROFLOW™
- MAAG® PUMP
- WILDEN®
- MOULINEX®
- REDSCREW™

PSG® Pumps & Technologies:
- PUMPS & SYSTEMS TECHNOLOGIES
  - CENTRIFUGAL
  - MIXERS
  - COMPRESSORS
  - SYSTEMS
  - GRISWOLD™
  - NEPTUNE™
  - BLACKMER®
  - AUTOMATIK®
  - SYSTEM ONE®
  - MOULINEX®
  - FLUID DYNAMICS™
  - MAAG® FILTRATION

PSG® Brands:
- APAQUE®
- ALMATEC®
- BLACKMER®
- ENVIRONEER®
- FLUID DYNAMICS
- GRISWOLD®
- MAAG® GROUP
- MOULINEX®
- NEPTUNE®
- QUATTROFLOW®
- REDSCREW®
- SYSTEM ONE®
- WILDEN®

brads of maag

maag
- pump systems
- automatik
- maag
- filtration systems

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Product Portfolio
Pelletizing System with Gear Pump and Screen Changer

Customers benefit: One stop shop & solution provider

Maag Melt pump
Maag Screen changer
Maag Melt pump

Automatic Underwater pelletizer
SPHERO®

Maintenance valve

Centrifugal dryer
CENTRO

Process water system

Loss in weight feeder
product portfolio

- gear pump
- screen changer
- diverter valve
- pelletizer

Brands of Maag combined into one system.
• Simple operation and uncomplicated screen changing
• Continuous, bump less (without pressure peak/drop) operation
• High operational reliability
• Short material residence time
• Leak-free mode of operation
• Low pressure consumption
• Flow channel geometry without any dead spots

• Simple operation with quick screen change
• High operational reliability
• Short material residence time
• Leak-free mode of operation
• Low pressure consumption
• Flow channel geometry without any dead spots
„Components to optimize your plastic processing system”

“in particular the use of a gear pump“
Functionality of a gear pump

gear pump technology for plastic processing applications
Today's Focus for presentation in following applications

Chemical process:
Transfer & pressurizing / extraction

Compounding:
Transfer & pressurizing / extraction

Polymer solution process:
Extraction, transfer & pressurizing

Virgin compounding
Transfer & pressurizing / extraction

Compounding / master batch
Transfer & pressurizing / extraction

Possibilities to increase output
Possibilities to increase efficiency

brands of maag

maag
- pump systems
- pelletizing systems
- filtration systems

maag
- pump systems
- pelletizing systems
- filtration systems

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pumps for plastic processing application

plastic processing & compounding

- capacity: up to 6 t/hr
- design viscosity: up to 30,000 Pas
- temperature: up to 350 °C
- suction pressure: up to 120 bar
- discharge pressure: up to 500 bar
- jacket pressure: electrical heated
- jacket temperature: up to 350 °C

virgin compounding

- capacity: 1 to 100 t/hr
- design viscosity: up to 20,000 Pas
- temperature: up to 350 °C
- suction pressure: up to 70 bar
- discharge pressure: up to 350 bar
- jacket pressure: up to 25 bar
- jacket temperature: up to 320 °C

brands of maag

maag: pump systems
automatik: pelleting systems
maag: filtration systems
Virgin compounding

Compounding / master batch
Transfer & pressurizing / extraction

Possibilities to increase efficiency

- technical specialties of PVC soft applications
- Increase output
- Save energy & quality improvement
energy savings in extrusion application

Without gearpump

With gearpump

brands of maag

<table>
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Constant at pressure (outlet) side

Change of set value pressure suction side

LDPE + LLDPE (MFI ≈ 1)

\[ T_m \approx 170 \, ^\circ C \]

\[ m \approx 120 \, \text{kg/h} \]
Summary:

- Constant pressure at die (film, plate, tube) let you minimize the tolerance band while still remaining in the requested minimum film-, plate- or wall thickness.
- Raw material savings can beat up to 5%, depending on the application; specially for high performance polymers of significant impact and importance.
- As in the polymer virgin line, energy saving is given as well.
- Total line specific energy is reduced (approx. 20%).
- Reduction in overall melt temperature, with the pump installed in the extrusion line, the amount of regrind (non virgin material) can be increased and still remain in the requested temperature range.
- Production rates might be increased.
- Improved pellet, profile, film or sheet quality.
- Payback in 12 months or less.
- Available for throughputs from some kg/hr up to 100 tons/hr.
Adapted & improved flow – less degradation

With gearpump

brands of maag

maag
- pump systems

automatik
- pelletizing systems

maag
- filtration systems
Virgin compounding

Compounding / master batch
Transfer & pressurizing / extraction

Possibilities to increase efficiency

- technical specialties of PVC soft applications
- Increase output
- Save energy & quality improvement
Burned Material unacceptable

Degraded & thermally damaged PVC

Pump disassembly, after the use of too high temperature and also non improved flow channels for thermo sensitive products such as PVC - soft
Technical Overview
Optimized Pump for PVC Soft Extrusion

Tests in 2003, customer in Switzerland
1. Introduction
2. Pump design overview
3. Task customer production line
4. Solutions
extrex® melt pump

- adapter for thermocouple
- bore for heating cartridge or liquid heat / cooling
- drive shaft
- journal bearing
- visco seal (shaft seal)
- cooling ring for visco seal (optional)
- driven shaft
- housing/covers
The extrex® ST is used for bulk polymers (PE, PS, PP, PET, etc.) and for regular process conditions

• no dead spots

The extrex® SP is used for slight to medium thermo sensitive polymers (PC, PMMA, PA, PVC soft. foamed polymers etc.) and for applications requiring frequent product and/or color changes.

• no dead spots / zones
• optimized in- and outlet
return bore and V-groove
The extrex® SE is used for shear- and temperature sensitive polymers (PVC, cross linked PE etc.).

• no dead zones
• optimized in- and outlet
• drainage of highly sheared polymer (bearing lubricant)
• easy conversion to SC

The extrex® SC used for polymers of various degrees of sensitivity. By exchanging the bearings only and by switching the positions of the visco seal only, it can be converted into an extrex® SE.

• no dead spots / zones of low flow speed
• optimized in- and outlet
• no drainage of highly sheared polymer (bearing lubricant)
• easy conversion to SE
SE no return bore and no V-Groove

ST. SP. SC return bore and V-groove
1. bearing lubrication stream

2. leakage stream „axial clearance“

3. leakage stream „flank clearance“

4. leakage stream „tip clearance“
Burned Material

brands of maag

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</tr>
</tbody>
</table>

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Design changes December 2003 for test’s in production line

✓ Change from SP type to SE type (bleeding to the outside)
✓ Introduce optimised flow channel on outlet
✓ Add thin chrome coating on the pump body flow channel
✓ Change heating cartridges to zone heated (no heating power in the middle 1/3)

Changes in December 2003 for optimised handling of drained PVC
(Carried out still on SP type pump)

✓ Installation of viscoseal cooling
✓ Tests for appropriate cutting device of drained PVC (by Saranfil)
Pump design EX 90

Schnitt A - A

Schnitt B - B

brands of maag

maag
- pump systems
- pelletizing systems
- filtration systems

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Pump design EX 90

brands of maag

maag
- pump systems

automatik
- pelletizing systems

maag
- filtration systems
Changes June 2003

✓ Proposal for additional drained PVC collectors for pneumatical transport
lubricating path and volume
### Operating data:

10 - 126 Kg/h XLA fibers based on PE, rho 72 Kg/l, viscosity at 10s-1, 290°C, 431 Pas, dp= 190 bar

<table>
<thead>
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<th>pump</th>
<th>relevant volumes</th>
<th>process data pump</th>
<th>process data bearing</th>
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<tr>
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<td>volume (1 side)</td>
<td>specific volume</td>
<td>total volume lubricating path (1/2 return bore, lubricating film)</td>
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<tr>
<td></td>
<td>[cm³]</td>
<td>[cm³/rev]</td>
<td>[cm³]</td>
</tr>
<tr>
<td></td>
<td>min</td>
<td>max</td>
<td>min</td>
</tr>
<tr>
<td>28</td>
<td>27.3</td>
<td>10.2</td>
<td>64.8</td>
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<tr>
<td>36</td>
<td>48.5</td>
<td>25.6</td>
<td>122.6</td>
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<tr>
<td>45</td>
<td>84.6</td>
<td>46.3</td>
<td>215.6</td>
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</table>
Pump flow channel design

return bore and V-groove
lubricating path and volume
The new in-/outlet geometry

New design

Negative “plug“ shape of modified in- & outlet: better flow characteristics

SP design

Improved flow channel design
Color changeover – less contamination

2.09 Kg from blue to yellow
For testing reasons internal view of the produced flow:
- Single screw extruder
- lab set up
- no (tool / die) in order to have no backpressure to create worst situation therefore - no additional mixing effect.
Summary:

- Rapid color change over possible
- Even dark to light colors possible with minimal scrap / off spec material
- Use of same / similar equipment also for thermo sensitive products
- Raw material savings can beat up to 5%, depending on the application; specially for high performance polymers of significant impact and importance.
- As in the polymer virgin line, energy saving is given as well
- Reduction in overall melt temperature, with the pump installed in the extrusion line, the amount of regrind (non virgin material) can be increased and still remain in the requested temperature range
- Production rates might be increased @ tighter tolerances
- Improved pellet, profile, film or sheet quality
- Payback in 12 months or less depending on application & production parameters
Corrosion countermeasure:

- *material selection*
  - Maag supplies not only standard material
  - engineered solutions according customer request

Abrasion countermeasure:

- *material selection*
  - engineered solutions according customer request

- *larger pump size*
  - less velocity on the surfaces
  - less pressure contacts at same capacity

- *individually driven shafts*
  - divides the torque on two shafts
  - no touching teeth anymore
Summary:

- Gear pumps are technologically proven and cost effective
- In usage on the worldwide processing of poly-olefins and other polymers
- Supplied as a basic part of initial processing line
- Retrofit able to existing extruder/mixer with a minimum change of the overall layout
- Production rates are increased to significant levels (15-100%) with low overall investment
- Total line specific energy is reduced (approx. 20%)
- Reduction in overall melt temperature
- Improved pellet, profile, film or sheet quality
- Payback in 12 months or less
- Available for throughputs from some kg/hr up to 100 tons/hr
Sphero Pelletizer

Advantages for PVC pelletizing at a glance

brands of maag

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>pump systems</td>
<td>pelletizing systems</td>
<td>filtration systems</td>
</tr>
</tbody>
</table>
Why pelletizing PVC?

- If downstream processing requires **consistent input material properties** and excellent free-flow behavior
  - e.g. wire and cable manufacturing
  - Pipes, profiles, fittings, containers
  - E&E housings
- If the application requires clean and hygienic, i.e. **dust-free products**
  - e.g. for pharmaceutical and medical tubes, sheets, containers
  - Products which shall be coated downstream
- Better material feeding (vs. powder)
- Higher output / capacity
- Increased flexibility / easy cleaning
Why underwater pelletizing of PVC?

- Advantages
  - > 20% higher output vs. strand and dry die-face pelletizing
  - Reduced risk of agglomerates
  - ~25% lower dust content
  - Processing of sticky materials and micro-pellets possible

Size distribution of powder and pellets
How pelletizing PVC?

- **SPHERO® underwater pelletizing system – the better alternative**

Legend:
1. Start-up valve
2. Die plate
3. Cutting chamber
4. Drive with knife head
5. Centrifugal dryer / belt dryer
6. Process water system
Why SPHERO® pelletizing?

• Highlights

- Simple, streamlined process water piping
- Quick product changes due to very short cleaning time
- The tangential flow into and out of the cutting chamber ensures optimized flow dynamics
- Convenient single-hand operation for opening and closing of the cutting chamber
- SuperFlow die plate provides optimal thermal insulation (energy savings > 25 %)
- Unrivalled long lifetime of cutting tools
SPHERO® – the ergonomic system

**Machine base frame**

- Machine base frame concept with overhead mounting – no rails, grooves, channels on the floor – for more convenience and ergonomics

- More convenient handling through large space for upstream components (e.g. start-up valve, screen changer or extruder)

- Vibration-free, as all SPHERO components are fixed with springs at the machine base frame

- Integrated device for easy transport

- Operator panel and hydraulic unit at the rear leg of support frame for easier access
What makes the difference?

**Cutting head**

- Long life time of knives
- A universal joint (integrated into the cutting head) allows the cutter hub to move flexibly, thus ensuring that the cutting edges remain perfectly aligned to the die plate, with evenly distributed force.

- Maximum machine availability
- Knives have a wear zone of 8 mm
- The form of the cutting head permits using a larger variable number of knives.
Virgin compounding

Transfer & pressurizing / extraction

Possibilities to increase output

- Increase output
- Save energy
pumps for plastic processing application

plastic processing & compounding

- **extrex®**

<table>
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<tr>
<th>Feature</th>
<th>extrex®</th>
<th>polyrex®</th>
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<tbody>
<tr>
<td>Capacity</td>
<td>up to 6 t/hr</td>
<td>1 to 100 t/hr</td>
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<tr>
<td>Design Viscosity</td>
<td>up to 30,000 Pas</td>
<td>up to 20,000 Pas</td>
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<tr>
<td>Temperature</td>
<td>up to 350 °C</td>
<td>up to 350 °C</td>
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<td>Suction Pressure</td>
<td>up to 120 bar</td>
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<td>Discharge Pressure</td>
<td>up to 500 bar</td>
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<td>Jacket Pressure</td>
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<td>up to 25 bar</td>
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<tr>
<td>Jacket Temperature</td>
<td>up to 350 °C</td>
<td>up to 320 °C</td>
</tr>
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</table>

brands of maag

- **maag** pump systems
- **maag** filtration systems
- **automatik** pelletizing systems
benefits of using a gear pump

**How:** separate the fluxing and mixing phase from the pressure building phase

**Customer benefits:**
- Lower specific energy overall (20%)
- Increased rates (from 15 to 100%)
- Reduction in overall melt temp.
- Surge free flow to pelletizer
- Reduction of screw and barrel wear
- Improved pellet quality
- Overall improved efficiency
- Adaptable to all extruders/mixers
- Payback in less than 12 months

**Goal:**
- Energy savings, higher output and higher quality product.
- Consistent pellet, profile, film or sheet size.

**brands of maag**
- **maag**
  - pump systems
- **automatik**
  - pelletizing systems
- **maag**
  - filtration systems

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What is the market looking for?

- Higher throughput
- Flexibility
- Lower operating costs
- Resistance against abrasion and corrosion
- Increased efficiency
- Increased product quality
Maag’s solutions to increase throughput

- larger pump sizes
- material selection for bearings
- shaft cooling (applicable for sizes ≥ 180)
- bearing cooling (applicable for sizes ≥ 180)
Factors in scale-up in classical gear pump design:

- speed
- heat generation ( \( \sim \text{size}^3 \) )
- heat extraction ( \( \sim \text{size} \) )
- bearing load capability
- polymer flow effects (viscoelasticity)
- shaft sealing capability
- load capability of the polymer as a lubricant between teeth

LIMITING LAWS IN SCALE UP AND LIMITING FACTORS ON GEARPUMPS: Bearing temperature
gear pumps for large scale production

gear pump system polyrex®

higher throughput  
lower operating costs  
increased efficiency  
resistance against abrasion and corrosion  
flexibility  
increased product quality

reduction gear  timing gear  toothed coupling

combi gear

polyrex® gear pump

brands of maag

maag  pump systems  automatik  pelletizing systems  maag  filtration systems
shaft cooling gear pumps for large scale production
shaft cooling gear pumps for large scale production

brands of maag

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shaft and bearing cooling system

Increase of throughput

Heat generation (~ size^3)  
Heat extraction (~ size)  

Basic limitations  
Combined cooling  
Shaft cooling  
Without cooling  

Limiting Laws in Scale up

Rate (non-linear scale)

Pump-Size (non-linear scale)

+100%

+50%

size ≤ 180  
size ≥ 180

maag  
automatik  
maag

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shaft and bearing cooling system

Product: HDPE MFI = 0.25

- Bearing Temperature (limiting factor)
- Throughput in function of pump rpm
- Pump speed
- Brands of Maag:
  - Maag
  - Automatik
  - Maag

- Gear pump without cooling
- Gear pump with shaft cooling
- Bearing Temperature shaft- and bearing cooling

- ~ 30% increase of capacity
- ~ 50% increase of capacity
- ~ 100% increase of capacity

Increase of throughput

Brands of Maag

- Pump systems
- Pelletizing systems
- Filtration systems
Virgin compounding

Transfer & pressurizing / extraction

Possibilities to increase output

- Increase output
- Save energy & quality improvement
Example

A PE manufacturer has a line producing 15 mt/h:

<table>
<thead>
<tr>
<th>0.3 HDPE</th>
<th>Twin Screw</th>
<th>Twin Screw with Gear Pump</th>
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<tbody>
<tr>
<td>Melting</td>
<td>0.15 kWh/kg</td>
<td>0.15 kWh/kg</td>
</tr>
<tr>
<td>Pressure building in extruder</td>
<td>0.08 kWh/kg</td>
<td>0.01 kWh/kg</td>
</tr>
<tr>
<td>Pressure building in gear pump</td>
<td>- kWh/kg</td>
<td>0.02 kWh/kg</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0.23 kWh/kg</td>
<td>0.18 kWh/kg</td>
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Operating this line with a gear pump would save 0.05 kWh/kg
**energy savings (2)**

**Pure energy savings**

<table>
<thead>
<tr>
<th>t / hr</th>
<th>Philippines Pesos savings / year @ 4.074 per KWh [PhP]</th>
<th>Philippines Pesos savings / year @ 5.022 per KWh [PhP]</th>
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<td>1'759'968</td>
<td>2'169'504</td>
</tr>
<tr>
<td>5</td>
<td>8'799'840</td>
<td>10'847'520</td>
</tr>
<tr>
<td>10</td>
<td>17'599'680</td>
<td>21'695'040</td>
</tr>
<tr>
<td>20</td>
<td>35'199'360</td>
<td>43'390'080</td>
</tr>
<tr>
<td>30</td>
<td>52'799'040</td>
<td>65'085'120</td>
</tr>
<tr>
<td>40</td>
<td>70'398'720</td>
<td>86'780'160</td>
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<td>87'998'400</td>
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<tr>
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<td>175'996'800</td>
<td>216'950'400</td>
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</table>

**in PhP per annum (at 360 day continuous 3 shift)**

<table>
<thead>
<tr>
<th>t / hr</th>
<th>Philippines Pesos savings / year @ 4.074 per KWh [PhP]</th>
<th>Philippines Pesos savings / year @ 5.022 per KWh [PhP]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>43'220</td>
<td>53'277</td>
</tr>
<tr>
<td>5</td>
<td>216'098</td>
<td>266'383</td>
</tr>
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<td>532'765</td>
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<td>2'160'977</td>
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<td>75</td>
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<td>3'995'738</td>
</tr>
<tr>
<td>100</td>
<td>4'321'953</td>
<td>5'327'651</td>
</tr>
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</table>

**in US$ per annum (at 360 day continuous 3 shift)**

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**The payback for an gear pump investment is less than 1 year!**
shaft and bearing cooling system

Shaft and bearing cooling on a gear pump system has resulted in:

- **100% more throughput** capacity compared to no cooling,
  or **30% more capacity** compared to shaft cooling only
  - bearing cooling is now being used for “de-bottlenecking” existing lines
  - the larger capacity the more economic
shaft and bearing cooling system

Shaft and bearing cooling on a gear pump system is more than just an increase in throughput:

- higher differential pressure allowable for softer grades
  - more pressure available for higher quality filtration

- higher volumetric efficiency
  - pump runs at a lower speed for the same rate

- extends the operating range
  - not just limited to particular grades

brands of maag

<table>
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<tr>
<th>maag</th>
<th>automatik</th>
<th>maag</th>
</tr>
</thead>
<tbody>
<tr>
<td>pump systems</td>
<td>pelletizing systems</td>
<td>filtration systems</td>
</tr>
</tbody>
</table>
shaft and bearing cooling system

If you have a basic gear pump already operational, we can de-bottleneck your line today via:

- an “upgrade” package of cooling technology to shaft, bearing or both
- makes use of most of the existing parts
- minimal additional space required for upgrade
- time required for changeover is less than 1 – 1.5 week (standard shutdown)
- typical payback of less than a year for the end user
A gear pump system will address all market requirements!

brands of maag

maag
- pump systems
- pelletizing systems
- filtration systems

maag

A gear pump system will address all market requirements!
gear pumps up to mid scale production

gear pump system extrex® synchro

brands of maag

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</table>

higher throughput, lower operating costs, increased efficiency, increased product quality, resistance against abrasion and corrosion, increased efficiency, flexibility, increased product quality, higher throughput, decreased maintenance costs.
For more information, don‘t hesitate to contact us.

<table>
<thead>
<tr>
<th>Country</th>
<th>Address</th>
<th>Phone</th>
<th>Fax</th>
<th>Email</th>
<th>Website</th>
</tr>
</thead>
</table>
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Fax +41 44 278 82 01  
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www.maag.com | |

Thank you for your attention!
Thank you