

# Coating as a way to reduce energy consumption

- About the research shown in this paper
- What is coating (introduction)
- Why use coating / case from paper mill
- Conclusions part 1 (pumps)
- Part 2 – ventilators in tough environment (agriculture)
- Characteristics new - versus new coated surface
- Characteristics used - versus new surface
- Conclusions about coating for ventilators in agricultural sector
- What about the industrial sector, radial ventilators ?
- Next step



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# About the paper

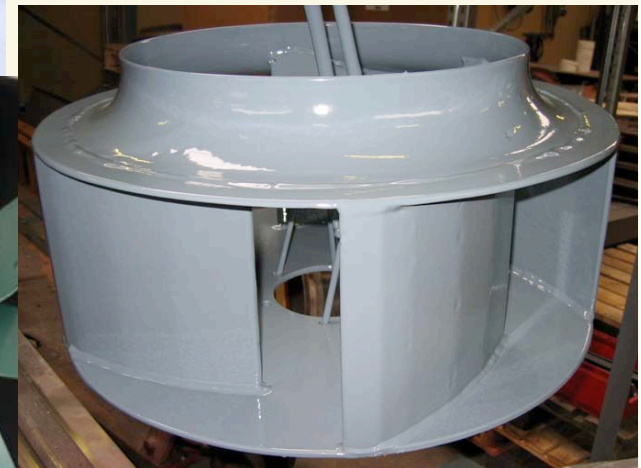
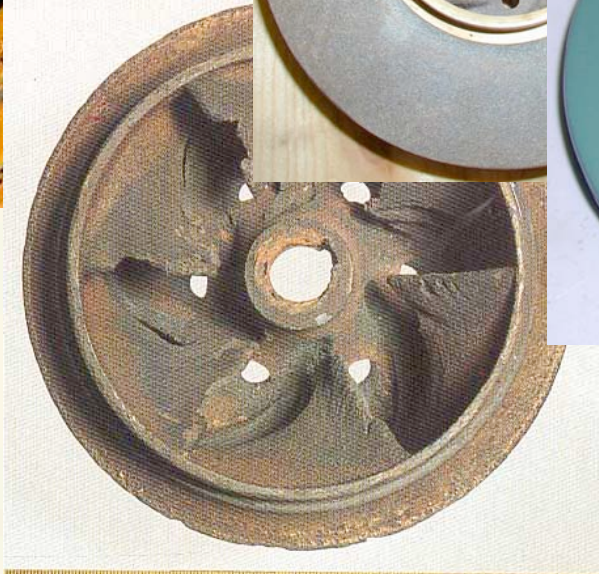
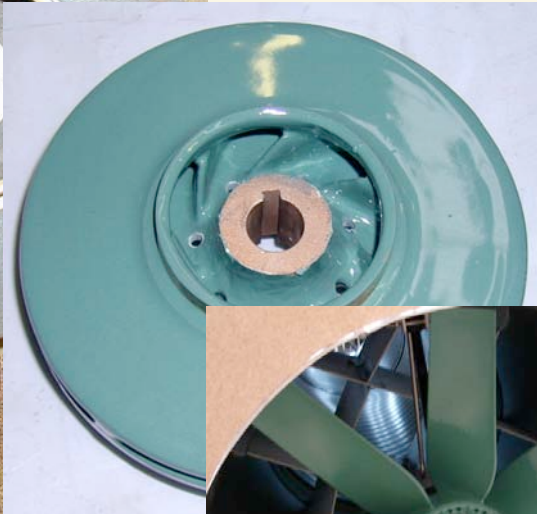
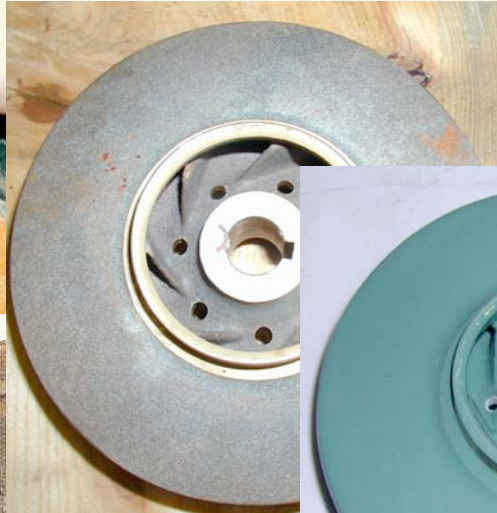
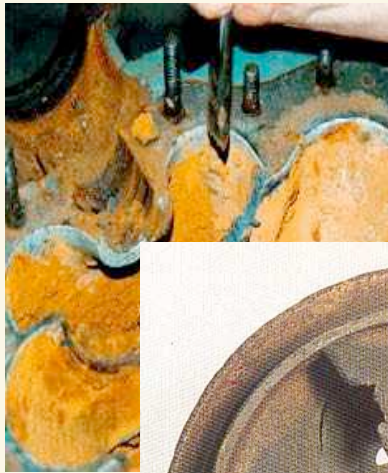
- Research project partly financed by ELFOR, see more on [www.elforsk.dk](http://www.elforsk.dk)
- EEMODS
- Partners of the project
  - Danish Technological Institute (measurements, analyses)
    - Hans Andersen (co- author)
  - Desmi (pumps), SKOV (ventilators)
  - Mastertech (Ceramic coatings)
  - Bygholm (Danish Agriculture Research)
  - Jakob Albertsen A/S (coating factory)
  - LokalEnergi (dissemination)
- Purpose of the project
  - Collect information about the coating technology
  - Dissemination of knowledge about the coating technology in DK
  - What is it - how does it work - what kind of benefits are there ?



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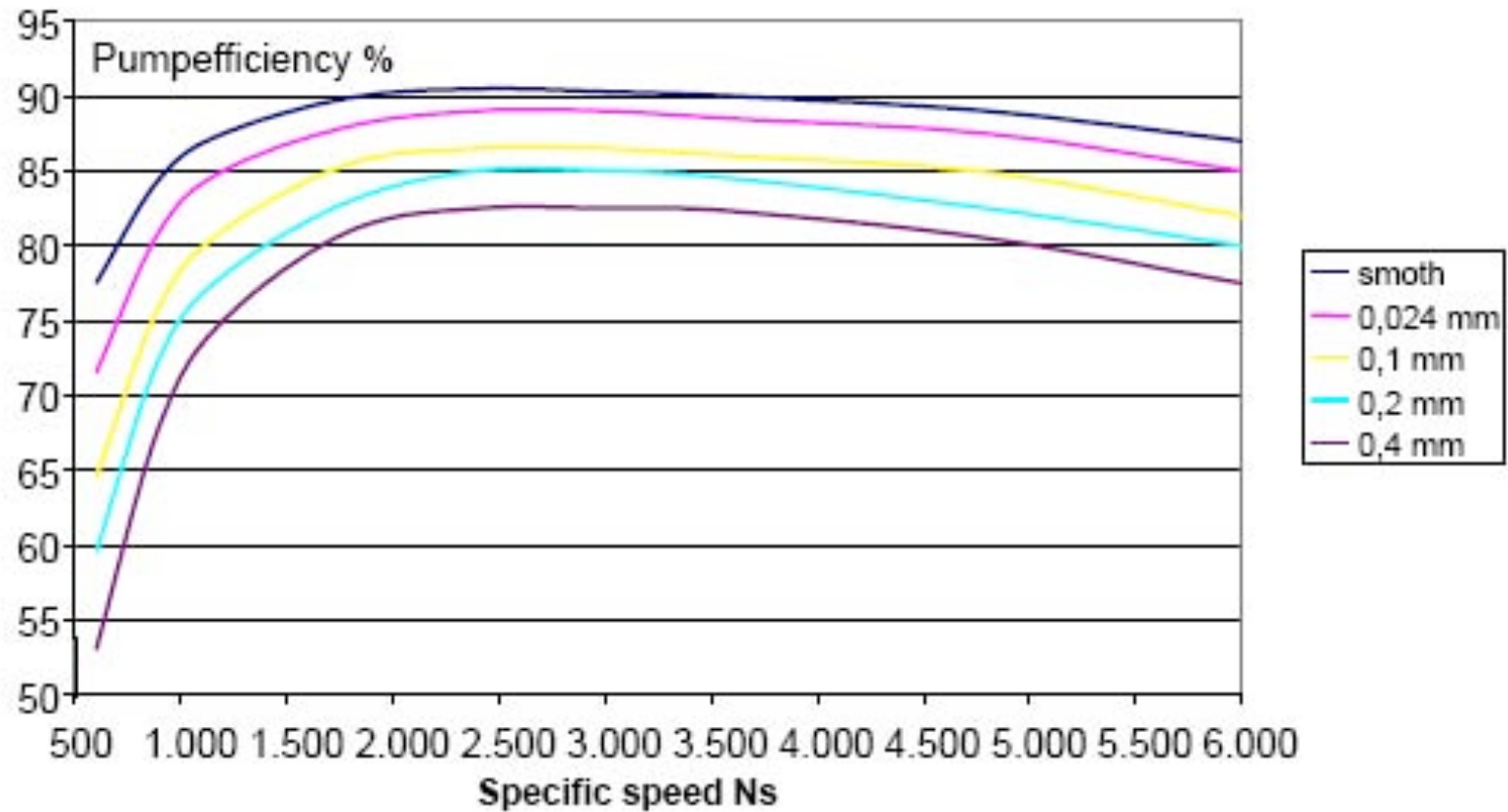
# What is coating - introduction





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## Pumpefficiency versus roughness



## Why ? - Case paper mill !

| Lifetime economics                |               |                 |
|-----------------------------------|---------------|-----------------|
|                                   | <b>Coated</b> | <b>Uncoated</b> |
| Pump cost                         | 7000          | 7000            |
| Maintenance - sealing             | 4875          | 4875            |
| Maintenance - wheel               | 0             | 4875            |
| Electricity                       | 360000        | 420000          |
| Coating cost (twice)              | 10000         | 0               |
| <b>Total cost 15 years period</b> | <b>381875</b> | <b>436750</b>   |

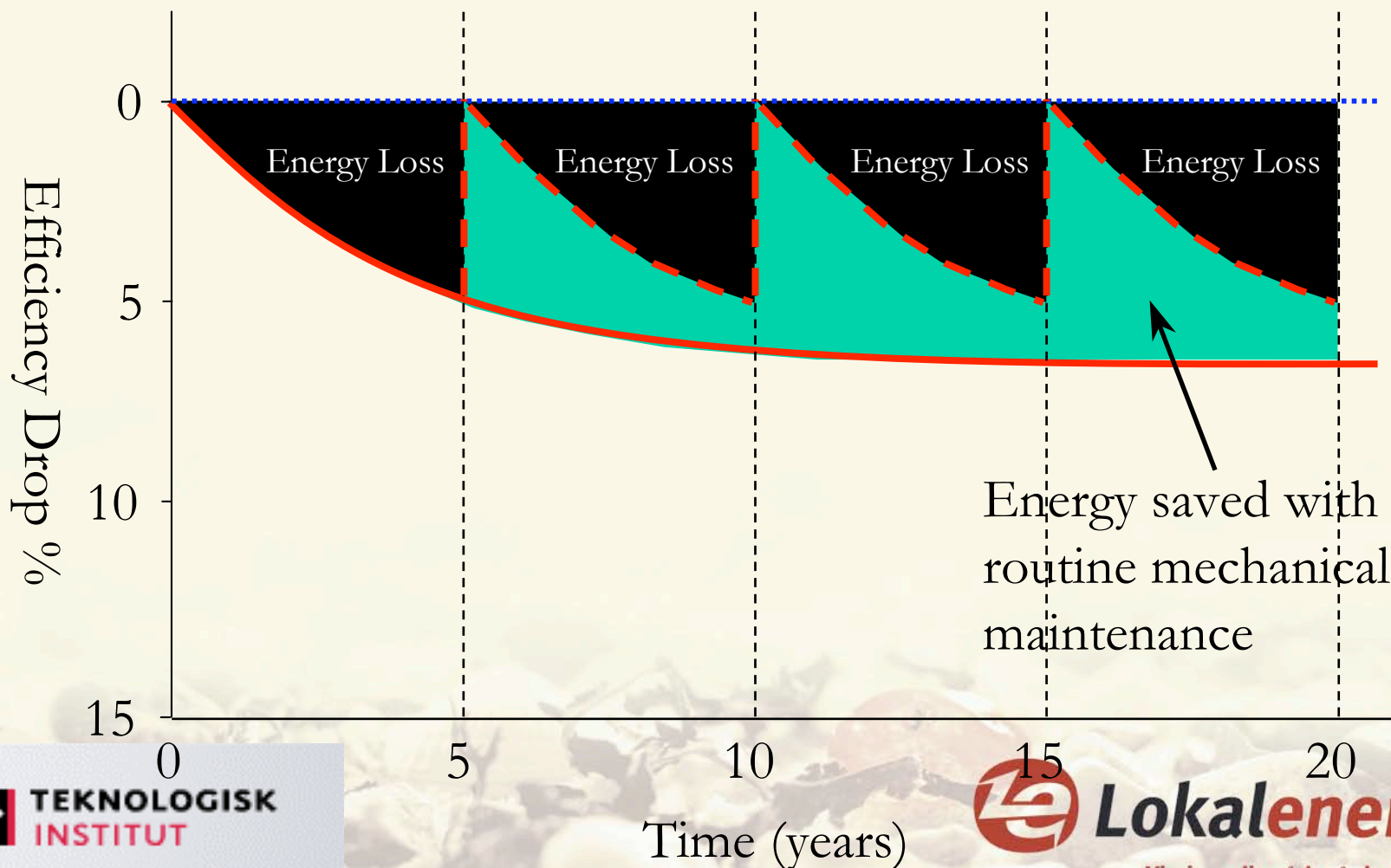
55 kW water pump , electricity price 8 Euro cent pr. kWh

Plus reduced “down time”



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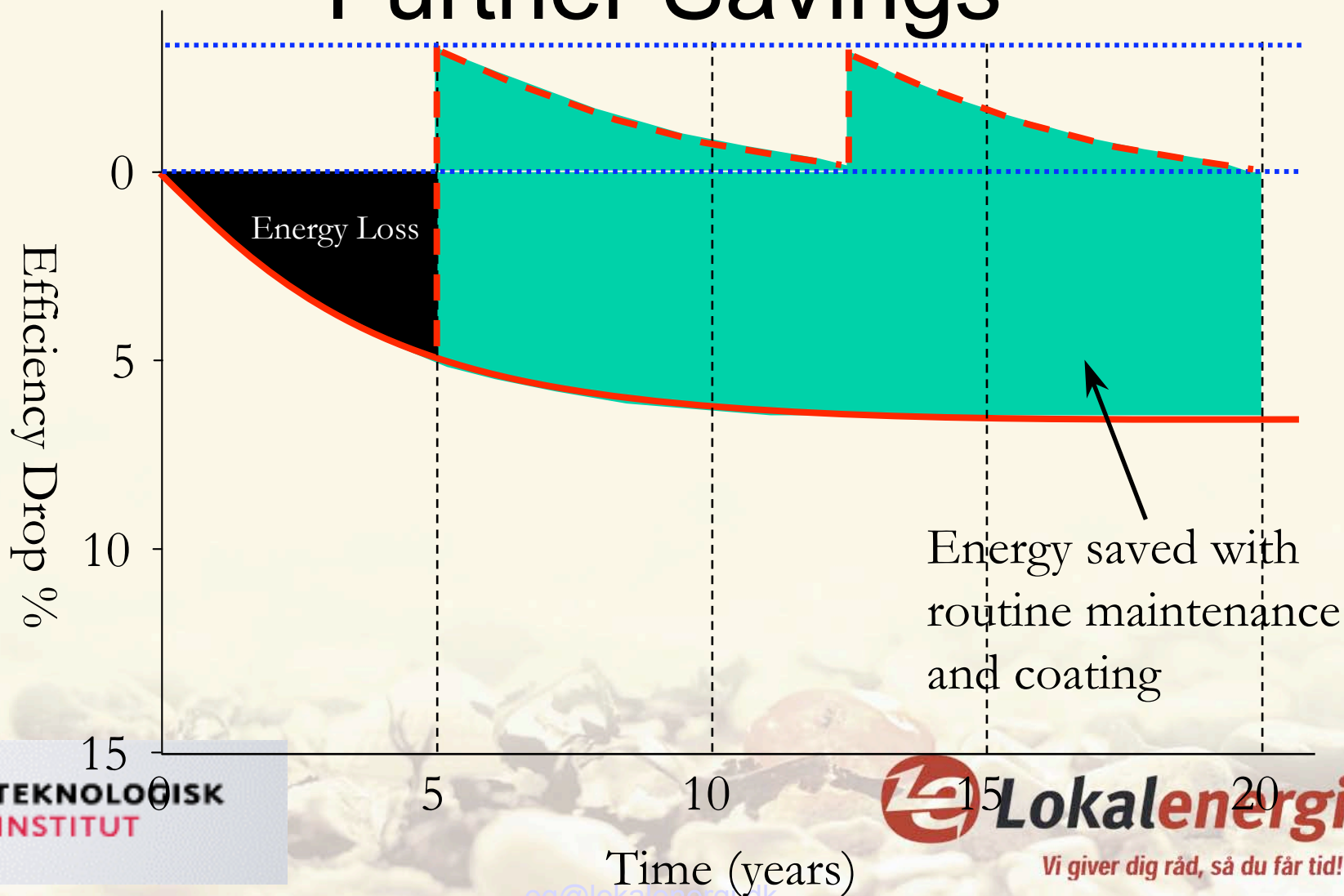
## Improvement during lifetime with planned maintenance !





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# Further Savings





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# Conclusions Part 1

|                          | hospitale<br>hospitale | hospitale<br>hospitale | hospitale<br>hospitale | hospitale<br>hospitale | hospitale<br>hospitale | hospitale<br>hospitale | hospitale<br>hospitale | hospitale<br>hospitale | hospitale<br>hospitale |
|--------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Flow [m <sup>3</sup> /h] | 15                     | 200                    | 200                    | 700                    | 300                    | 34                     | 34                     | 120                    | 450                    |
| $\Delta p$ [mWC]         | <b>6</b>               | <b>19</b>              | <b>14</b>              | <b>37</b>              | <b>30</b>              | <b>18</b>              | <b>18</b>              | <b>75</b>              | <b>15</b>              |
| N [o/min]                | 2840                   | 1450                   | 1500                   | 1325                   | 1445                   | 2900                   | 2900                   | 2915                   | 1460                   |
| $N_s$                    | 2850                   | 2250                   | 2950                   | 2350                   | 1950                   | 1950                   | 1950                   | 1250                   | 4060                   |
| $\eta_{before}$ [%]      | 34                     | 77                     | 58                     | 81                     | 72                     | 50                     | 50                     | 48                     | 50                     |
| $\eta_{after}$ [%]       | 34                     | 77                     | 69                     | 86                     | 74                     | 56                     | 57                     | 62                     | 52                     |
| $\Delta \eta$ [%]        | <b>0</b>               | <b>0</b>               | <b>19</b>              | <b>6</b>               | <b>3</b>               | <b>12</b>              | <b>14</b>              | <b>29</b>              | <b>4</b>               |
| Pump type                | C / gl                 | C / gl                 | C / gl                 | C / gl                 | C / gl                 | C / gl                 | C / gl                 | C / gl                 | Hidrost                |
| Sz. P <sub>2</sub> [kW]  | <b>0,75</b>            | <b>7,5</b>             | <b>11</b>              | <b>110</b>             | <b>37</b>              | <b>3</b>               | <b>3</b>               | <b>55</b>              | <b>30</b>              |
| Coat                     | 855 HT                 | 855 HT                 | S2                     | 855 HT                 | 855 HT                 | 855HT                  | S2                     | 855                    | 855                    |
| Status                   | <b>USED</b>            | <b>NEW</b>             | <b>USED</b>            | <b>USED</b>            | <b>NEW</b>             | <b>NEW</b>             | <b>NEW</b>             | <b>USED</b>            | <b>"NEW"</b>           |
| Environment              | Vand                   | Vand                   | Chlor                  | Vand                   | Vand                   | Vand                   | Vand                   | Vand                   | Slam                   |



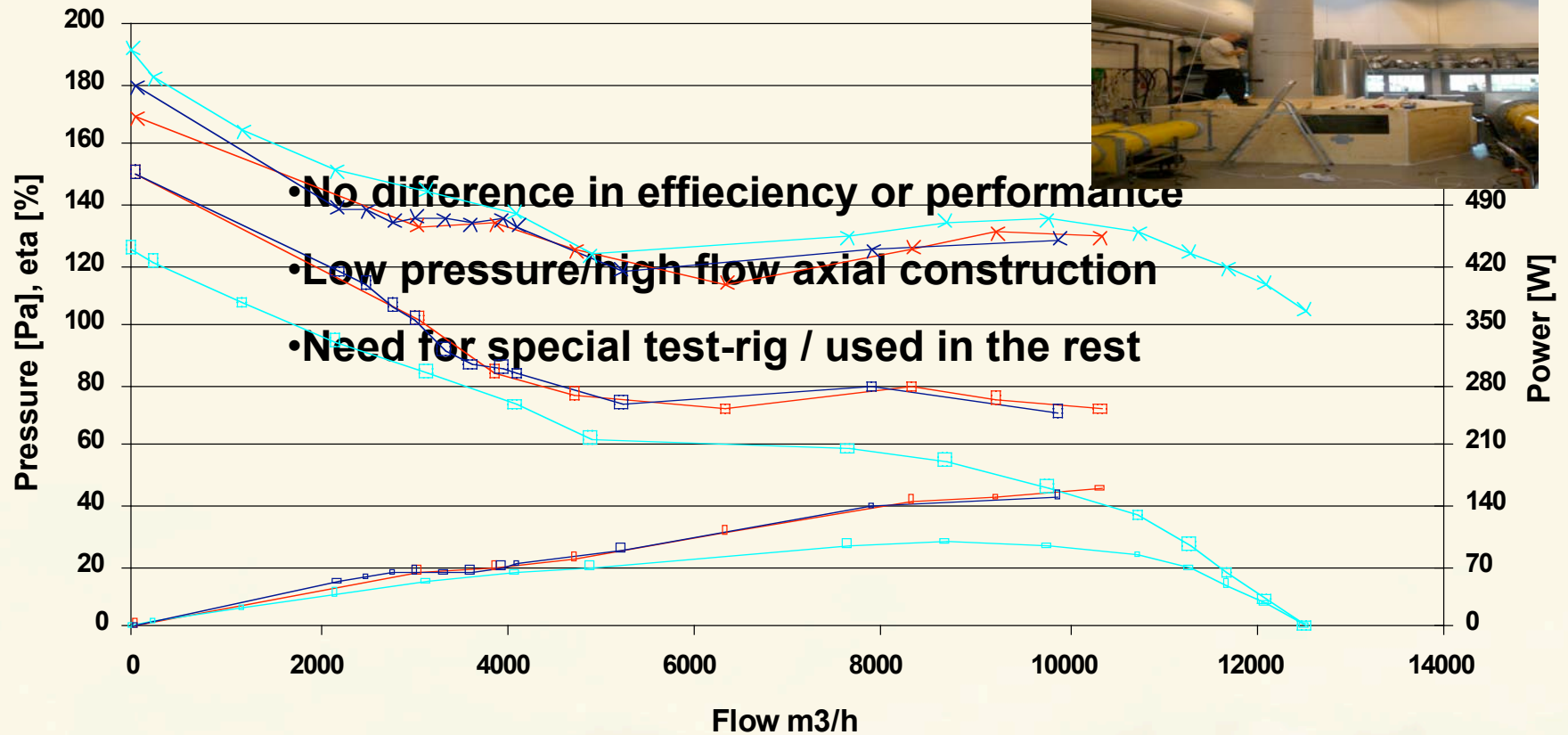
## Part 2 – Agricultural sector





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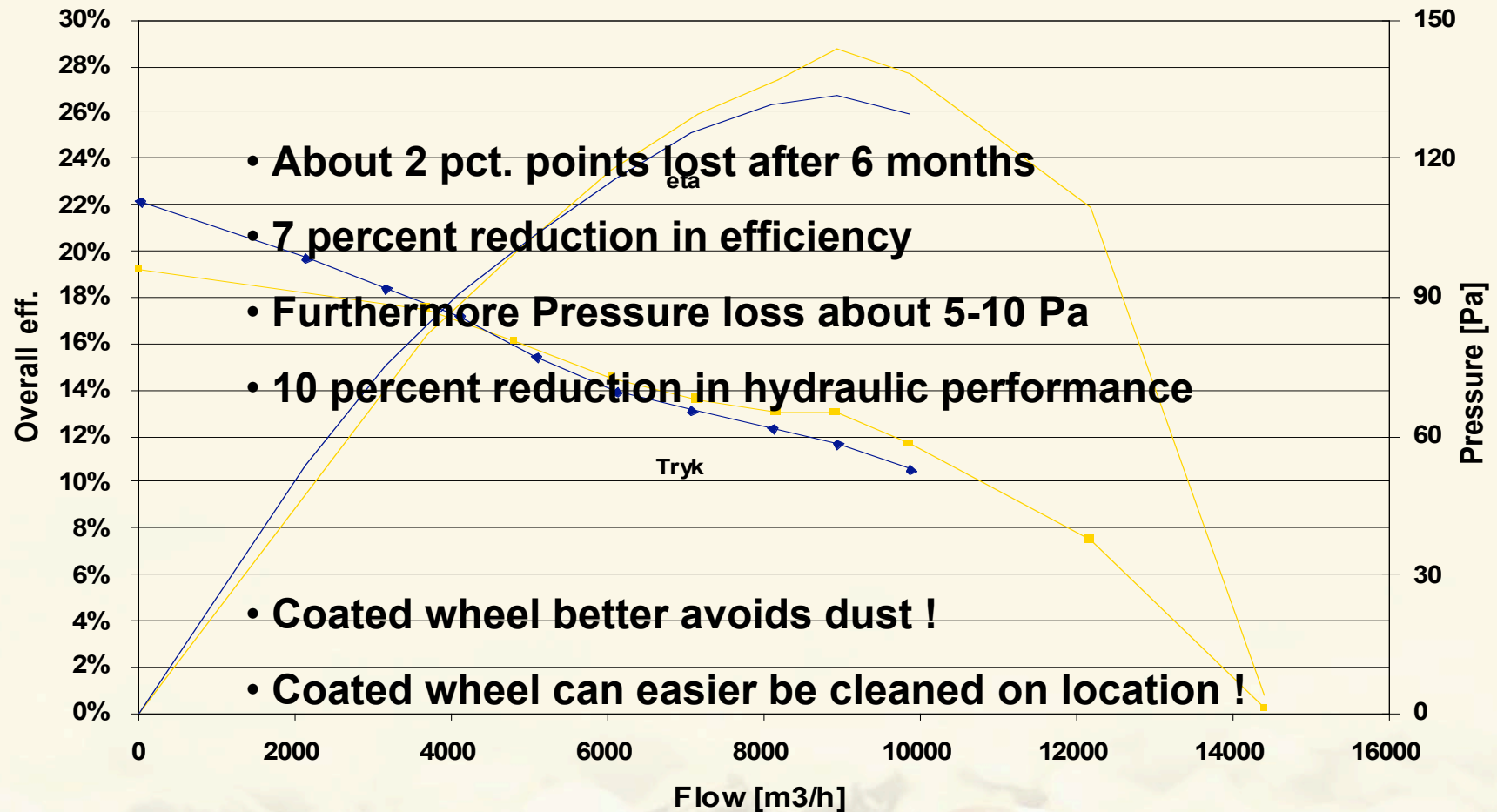
# New versus new coated single ventilator





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# Used versus new unit (channels & ventilator)



- About 2 pct. points lost after 6 months
- 7 percent reduction in efficiency
- Furthermore Pressure loss about 5-10 Pa
- 10 percent reduction in hydraulic performance
- Coated wheel better avoids dust !
- Coated wheel can easier be cleaned on location !

—■ Eta New      —◆ Eta Used  
—■ Pressure New      —◆ Pressure Used



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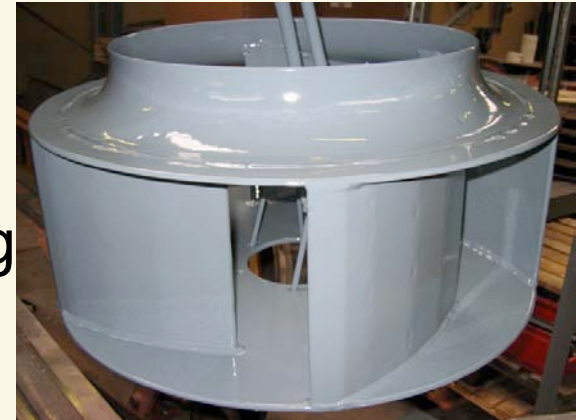
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## Conclusion agricultural sector

- No start potential – axial, low-pressure fans
- A lot of potential during lifetime / 7% after 6 months!
- A lot of potential in possible more accurate dimensioning / 10% loss of hydraulic performance after 6 months!
- A lot of additional potential by focusing on maintenance in general
- Still expensive technology according to energy-consumption for each ventilator.

## Industrial sector

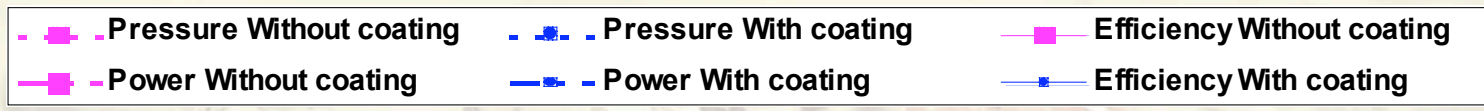
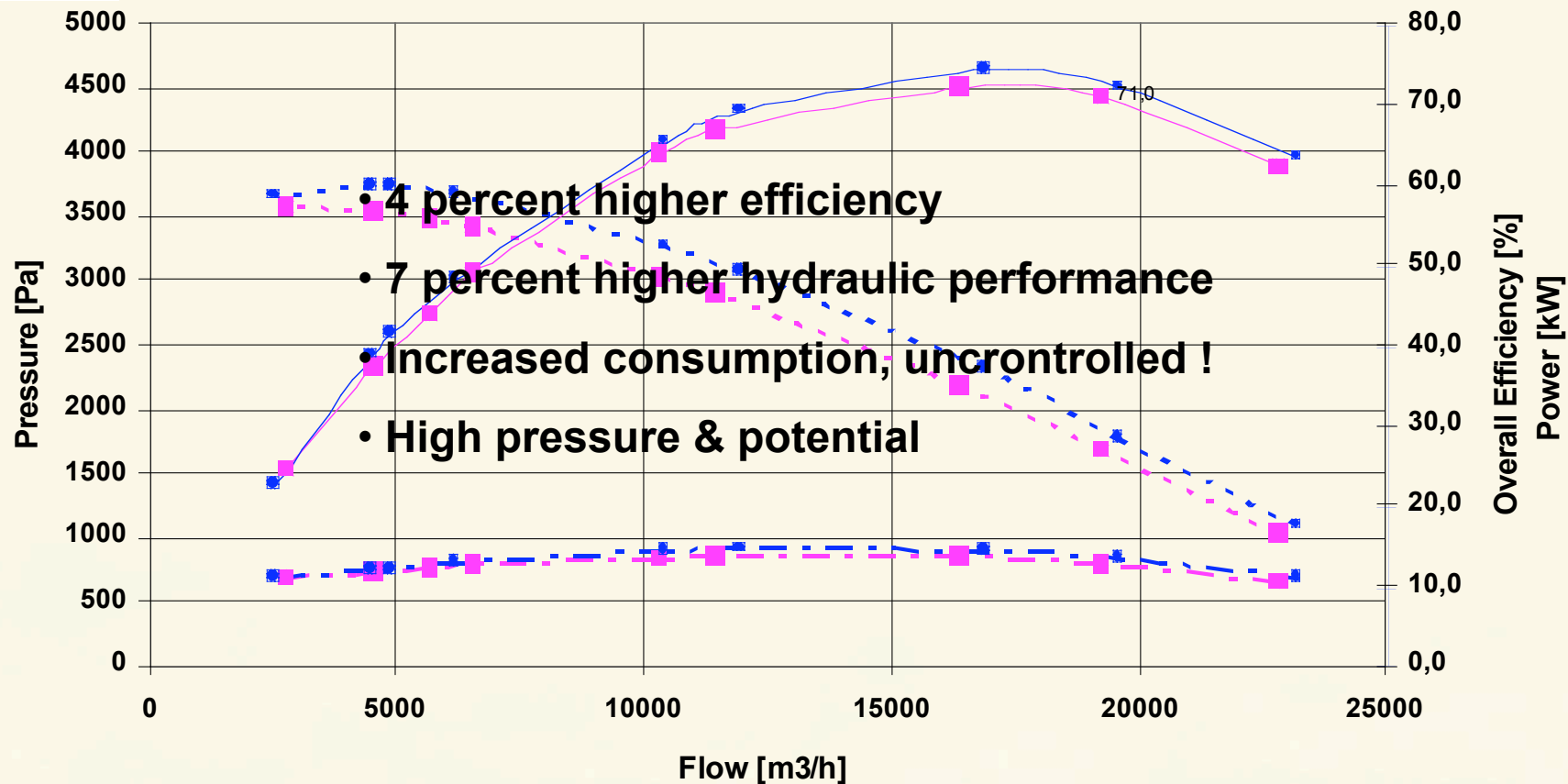
- Assumed start potential – radial, high-pressure fans / larger hydraulic losses due to friction in the ventilator housing
- Several types of use with a lot of potential during lifetime!
- A lot of additional potential by focusing on the need of air in general
- The price of technology better match energy-consumption for each ventilator
- One example measured already:





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# Industrial sector



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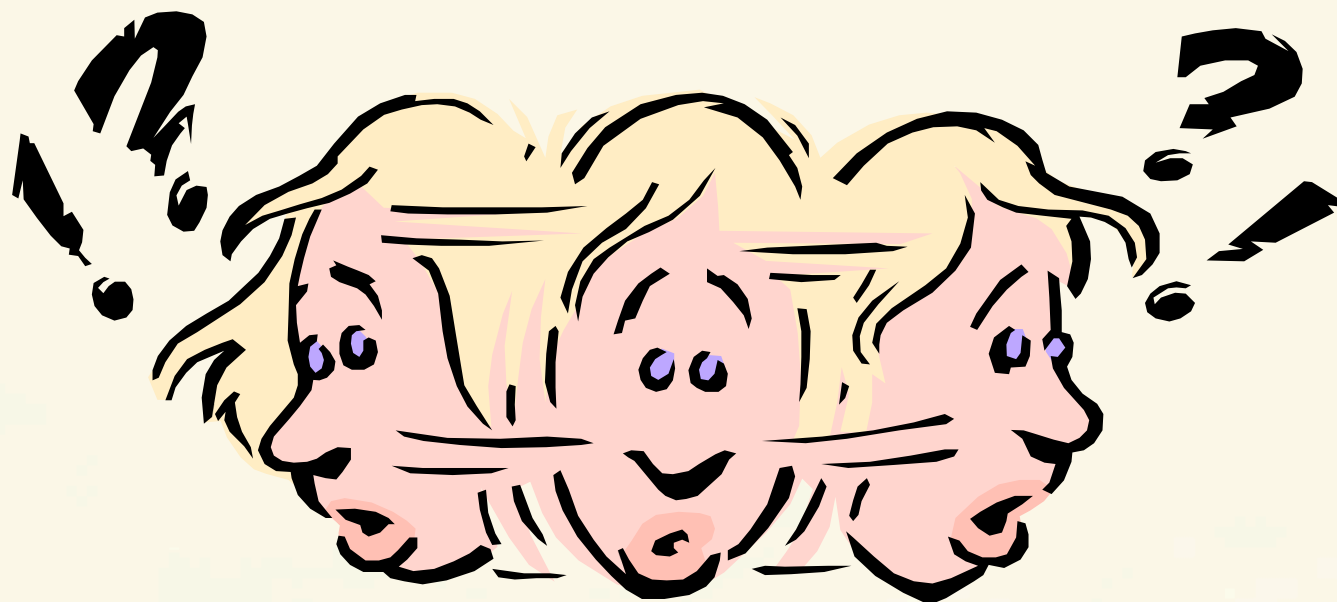
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## Next Step

- Development in ventilaton for agricultural use – coatings & in general
- New research projects about industrial ventilators
- Dissemination for end-users as energy service.
- Further research regarding coating material according to the application
- Penetration among OEM's



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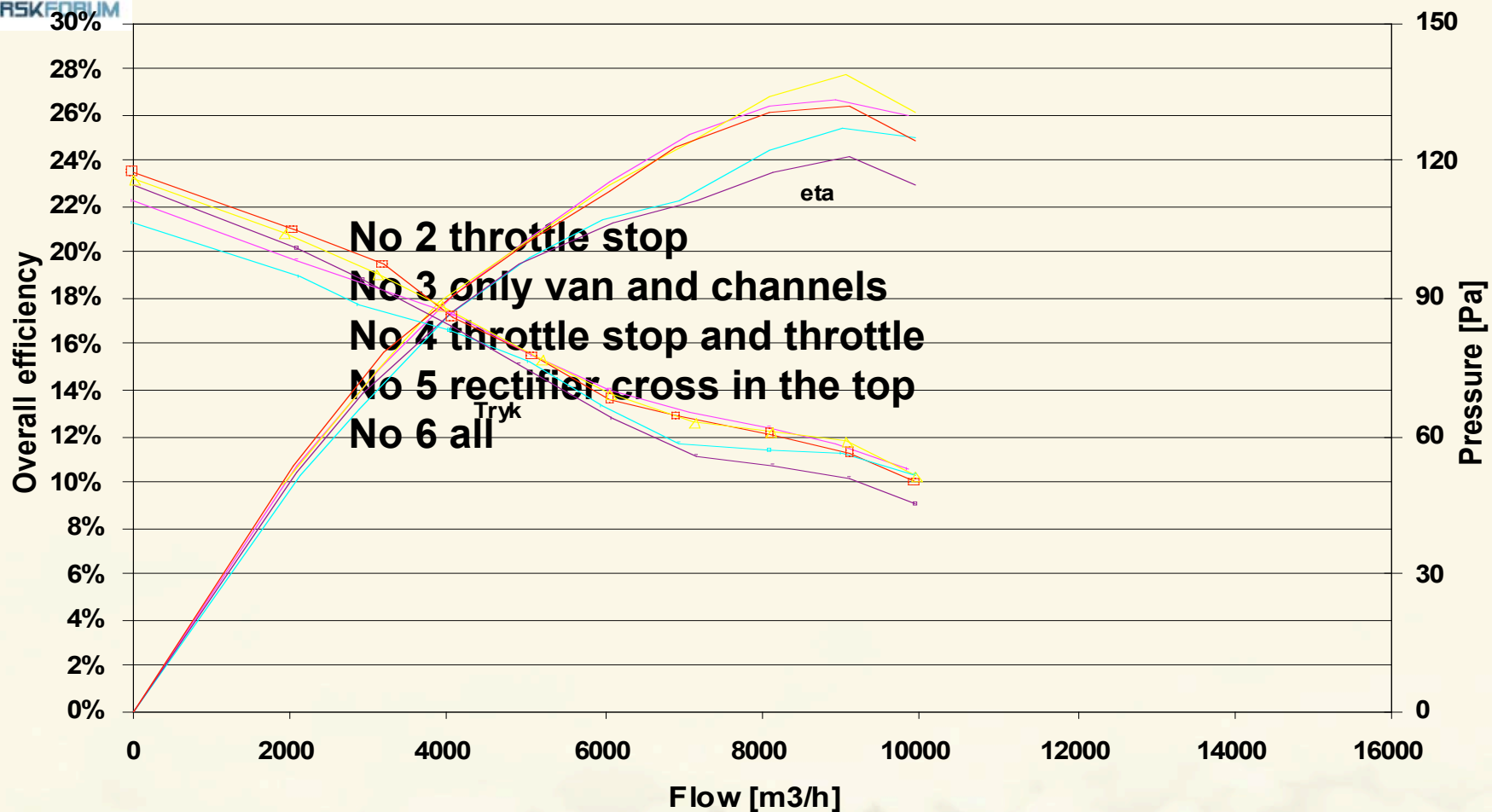
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# Maintenance in general – is important !



|                   |                   |                   |                   |
|-------------------|-------------------|-------------------|-------------------|
| eta måling 3      | eta måling 4      | eta måling 5      | eta måling 6      |
| eta måling 2      | pressure måling 2 | pressure måling 3 | pressure måling 4 |
| pressure måling 5 | pressure måling 6 |                   |                   |

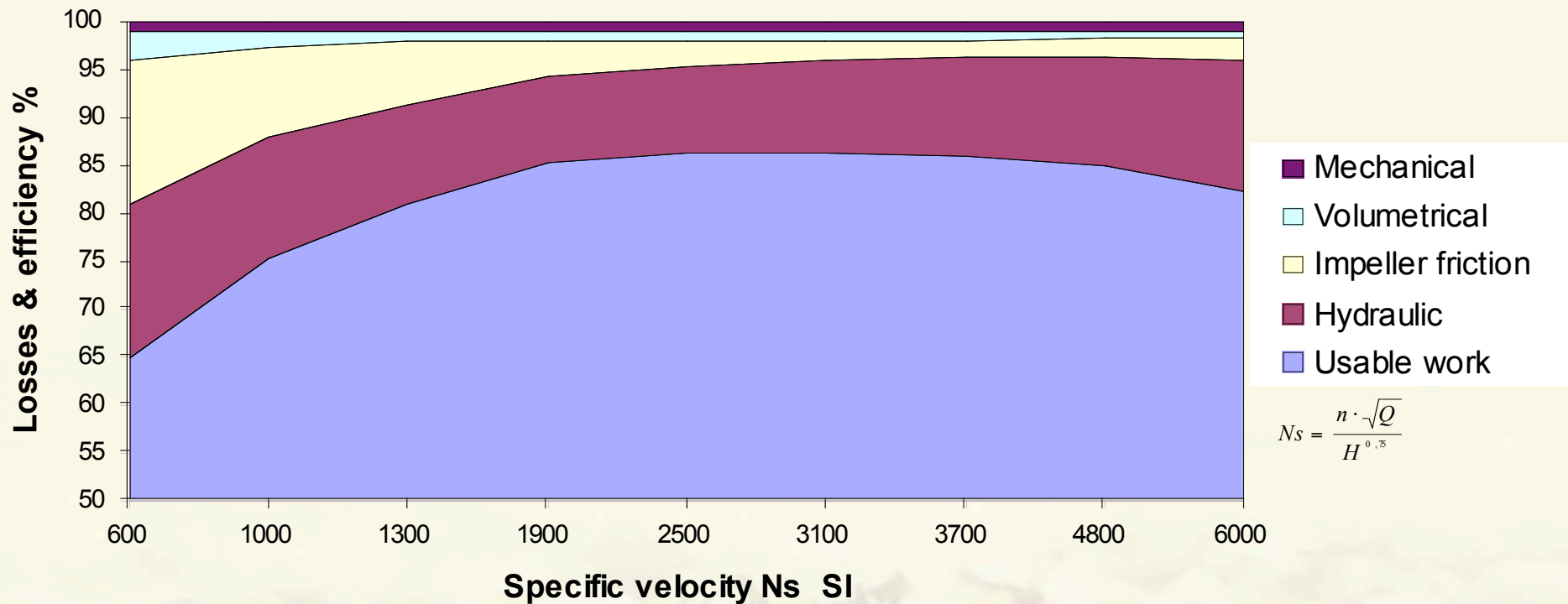


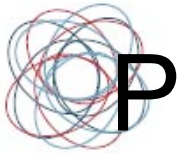
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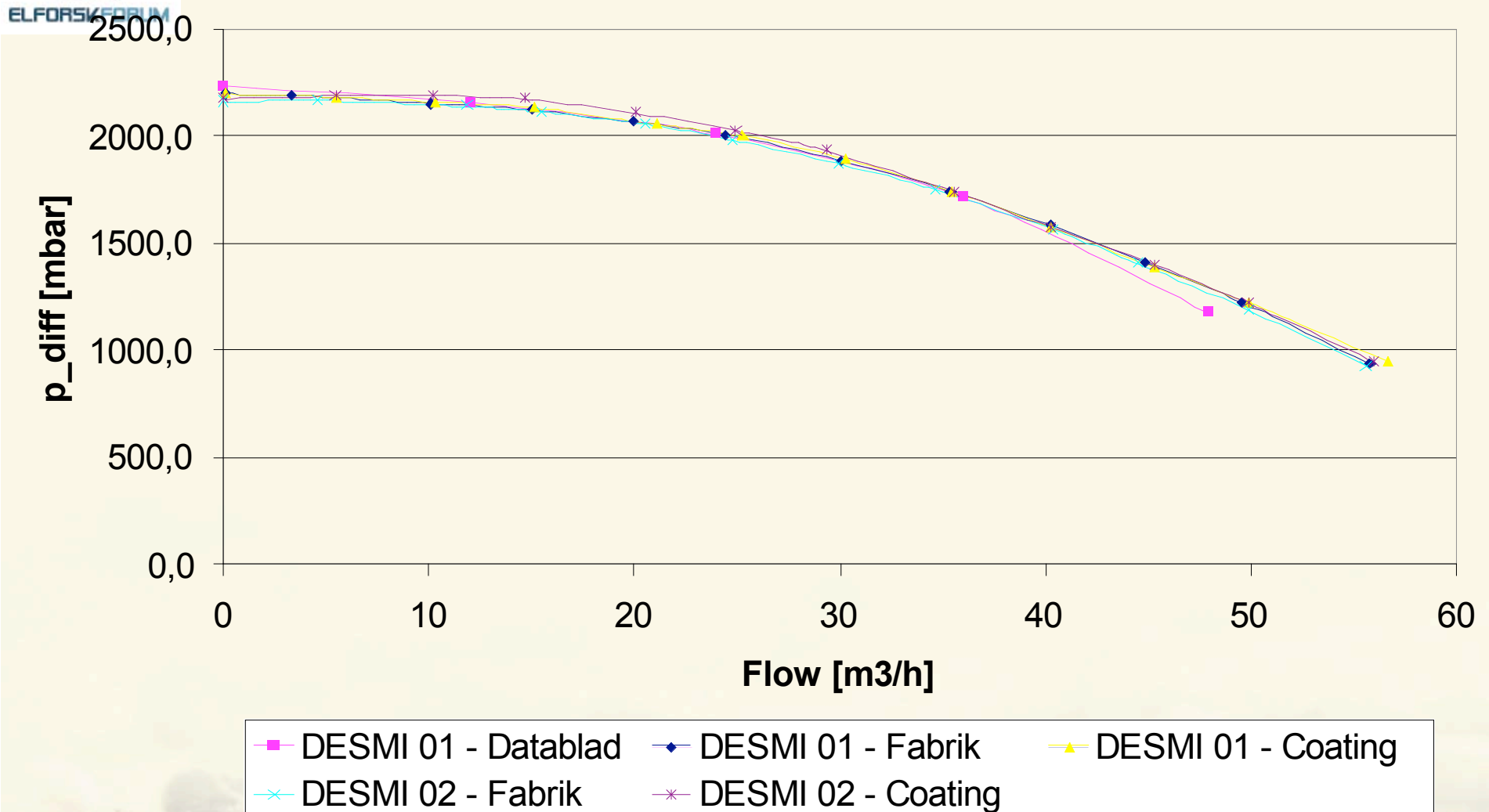
# How and why !

## Energy use in centrifugal pumps





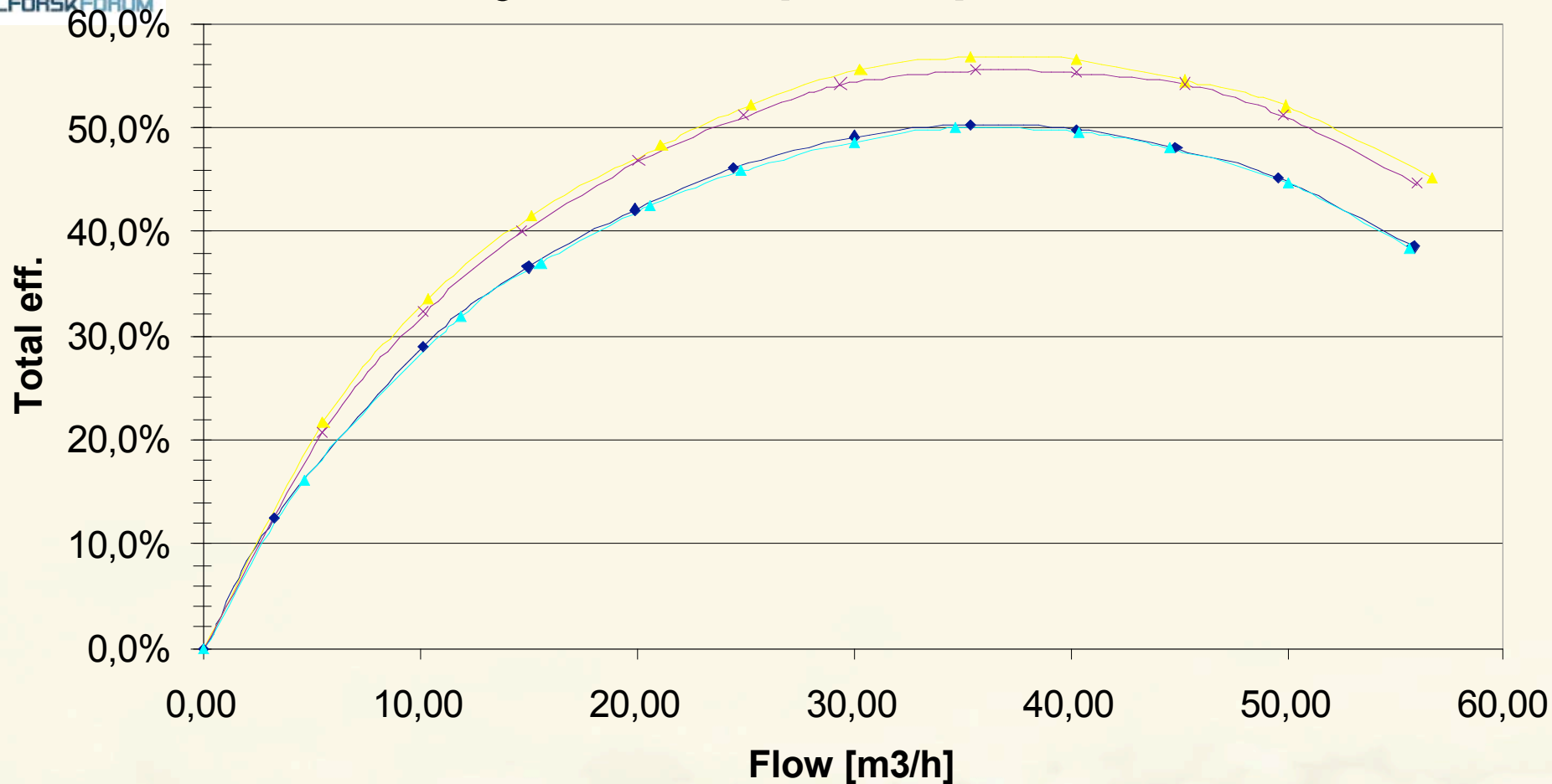
# Performance, new pump – 2,2 kW





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# Efficiency, new pump – 2,2 kW



◆ DESMI 01 - Fabrik    ▲ DESMI 01 - Coating    ▲ DESMI 02 - Fabrik    ✕ DESMI 02 - Coating



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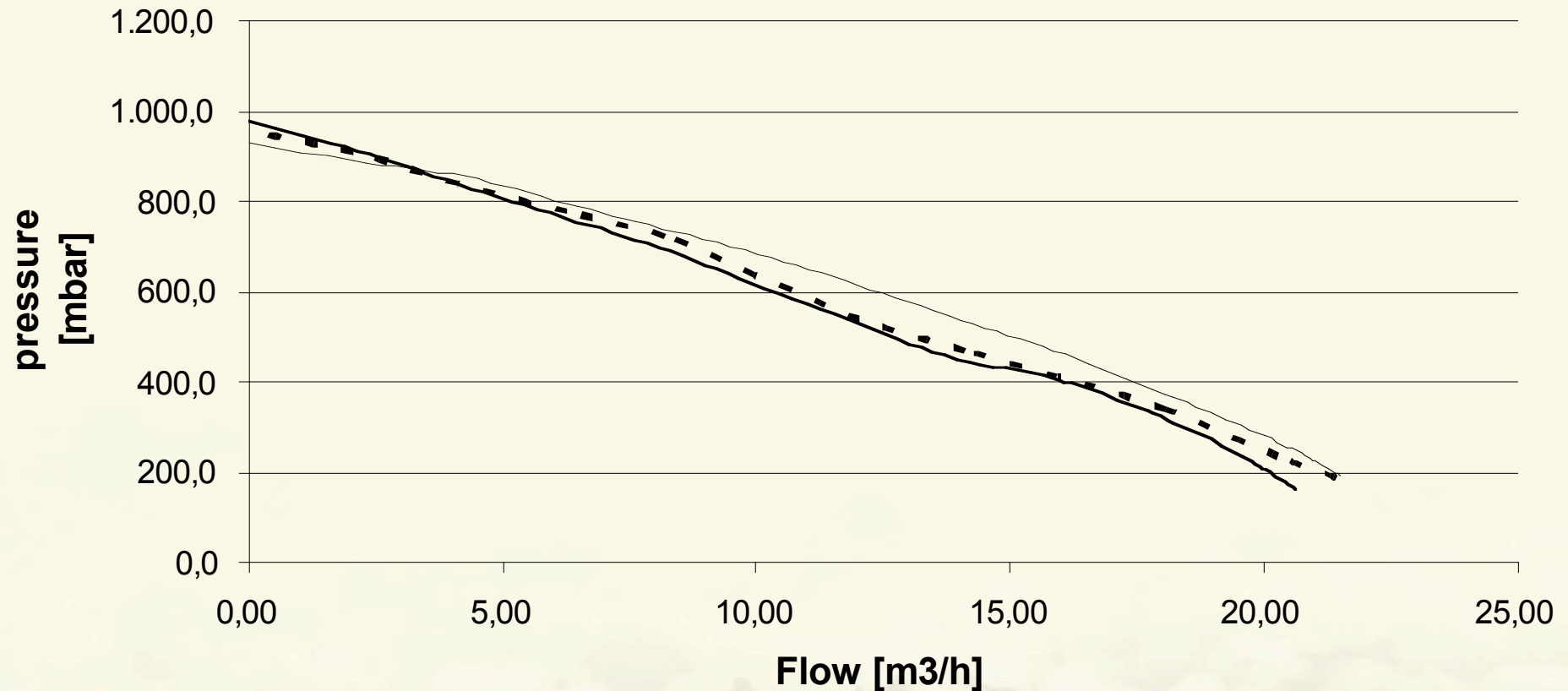
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# Performance, small pump – 0,2 kW

## Performance 3000 rev./min



— New pump   - - Coat impeller   — Total coat



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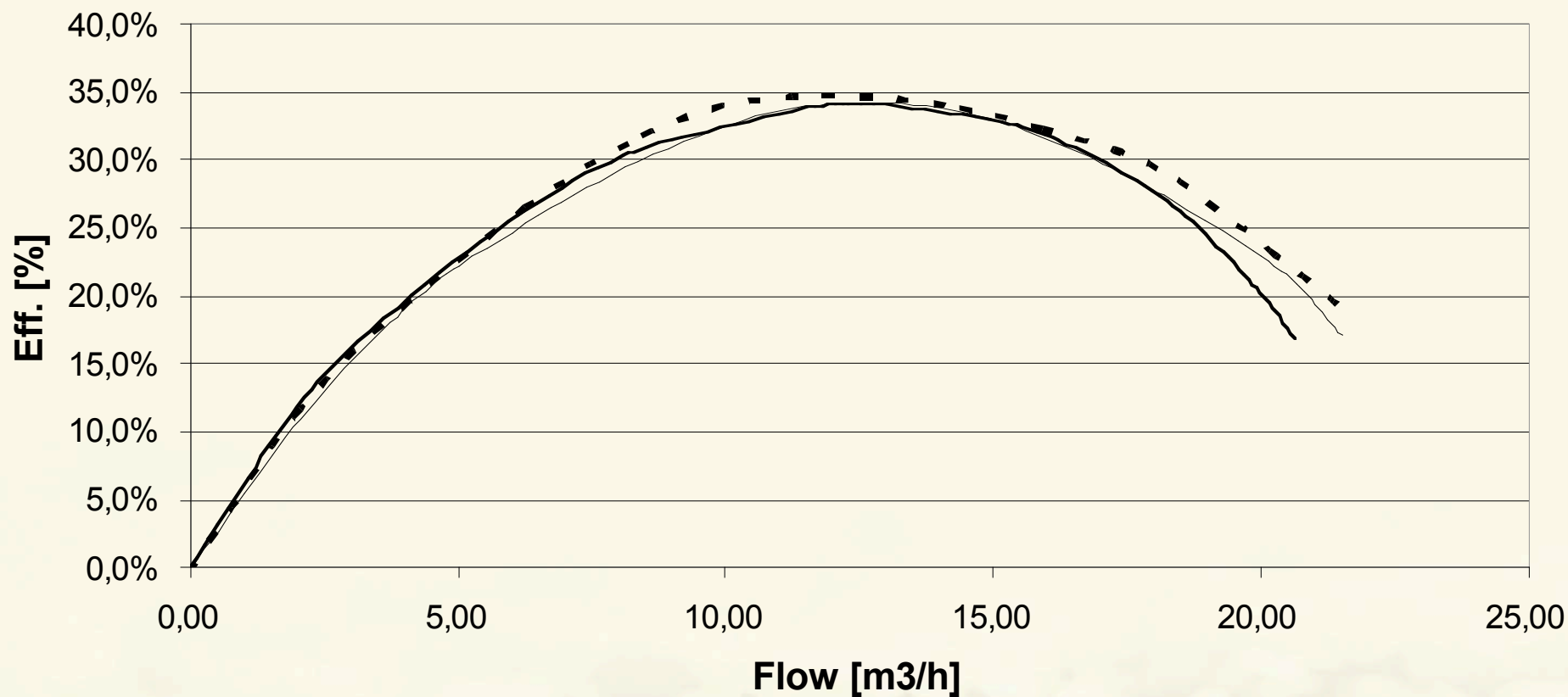
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# Efficiency, small pump – 0,2 kW

## Overall efficiency



— New pump - - Coat impeller — Total coat



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