Recovery Boiler Replacement Options

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Options for ageing recovery boiler

• What to do if the technical age of the recovery boiler is over
• Buy a new boiler to replace old, e.g.
  – Joutseno 1999  Värö 2002
  – Wisaforest 2004  Skoghall 2005
• Replace the furnace and add heating surface, e.g.
  – Veitsiluoto, Kemi 1999  Skutskär 2000
  – Äänekoski 2004  Bäckhammar 2001
Cumulative age of recovery boilers

Recovery boiler age as capacity of total capacity, %

- USA
- Sweden
- Finland
- Brazil

Years:
- 1960
- 1965
- 1970
- 1975
- 1980
- 1985
- 1990
- 1995
- 2000
- 2005
- 2010

Cumulative age of recovery boilers:
- 0%
- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%
Startup year of recovery boilers

- Finland
- Brazil
- Sweden
- USA

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Replacement options
Age of recovery boilers – maximum 30 – 40 a

• Brazilian recovery boilers
  – Median age according to total capacity 12 a
  – 75 % is younger than 19 a
  – 10 % is older than 29 a
• Finnish recovery boilers
  – Median age according to total capacity 15 a
  – 75 % is younger than 28 a
  – 10 % is older than 35 a
• Swedish recovery boilers
  – Median age according to total capacity 29 a
  – 75 % is younger than 35 a
  – 10 % is older than 40 a
• Recovery boilers in USA
  – Median age according to total capacity 30 a
  – 75 % is younger than 36 a
  – 10 % is older than 41 a
Replaced recovery boiler is ~ 29 years when the new starts.
Additional capacity with new boiler ~ 1200 tds/d
Why choose large retrofit?

- When you need less than 20% additional capacity
- Investment 15 – 45 M€
- Additional operating time needed only 10 – 15 a
- Possible to stop production for 45 – 60 days
- Need to decrease emissions -> new air system
- Often accompanied by increase in dry solids
Why buy a new boiler?

- Need additional capacity over 40 %
- Investment 100 – 200 M€
- Replace two boilers with one -> production efficiency
- Mill will be operating for 30 – 40 a
- Maintenance stop only 3 – 7 days
- Improved energy efficiency, more steam and power
- Decrease emissions to air
- Other replacements included (maintenance cost decreases)
  - electrification
  - automation
  - auxiliary equipment
New boilers are bought with higher solids

![Graph showing the increase in virgin dry solids from 1975 to 2010. The graph displays the average and maximum values over time.](image-url)
Typical new project in Scandinavia

• Replaces two boilers
  – Götaverken 1976 1300 tds/d
  – Götaverken 1964 590 tds/d
• Age of replaced boilers at 2007 = 31 and 43 a (av. 37 a)
  – Pietarsaari 29 and 42 a (both had a major modernization)
  – Kaukas 20 and 27 a
• Additioinal nominal capacity 2100 tds/d
  – Pietarsaari 2100 tds/d
  – Kaukas 1160 tds/d
There are peak periods of boiler purchases
There are peak periods of boiler purchases

- Almost no new projects at US after ’93
- Sweden replaces at rather flat rate of 1000 tds/d, except during the recession after ’91
- Finland had a peak in the beginning of 90’s that levelled to the same 1000 tds/d
World black liquor processing capacity keeps growing
Changes in pulp production

1000 tds/d to recovery boiler means ~200 000 ADt/a
Changes in pulp production – global view

1000 tds/d to recovery boiler means ~200 000 ADt/a
As units get bigger the number of units decreases
Market share of recovery boiler capacity sold*

*Excluding former soviet block and China
Single drum boilers

• All recovery boilers used to be two drum design. One of the main reasons to move to single drum design was the size of the boilers. Tube stiffness limits cross flow two drum arrangement to about 2300 tds/d size and vertical flow two drum constructions have suffered from plugging because of vibration stiffeners.

• The first modern single drum recovery boiler was delivered in 1984 by Götaverken to Leaf River, the boiler size was 1966 tds/d, By 1990 all manufactures started to provide single drum boilers and excluding very small ones, all modern boilers are now single drum design.
Advantages of single drum construction:

• Single drum construction eliminates the possibility of water leakage to furnace as it is placed outside the furnace.
• There are significantly less holes in drum wall, which can be built thinner.
• Thinner wall of drum allows faster start-up and shut-down.
• The gas flow to the boiler bank is smoother and heating surface arrangement is simple.
• The erection period is shorter because of large block construction. There is no rolled tube work.
• The water circulation in the boiler is enhanced and steady due to separated and unheated downcomers.
Old two drum – replaced with modern single drum

- Lower furnace needed replacement
- Two drum boiler bank was old
- Vertical flow offered increased capacity
- Increase in dry solids
Summary

• 30 years means need to replace the recovery boiler
• 20 years is typical replacement age if mill capacity is increased
• Single drum conversion is fairly typical

• “Recovery boiler improvements do not guarantee mill viability” (Jim Rowland, Canadian Paper Analyst)