



# Firing practices in modern recovery boilers

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#### Recovery boilers change

Development continues Larger size Dry solids increases Improved air systems Higher loading How to lower NOL in forest industry



#### 2004 vs 2018

- In 2004 Finnish Recovery Boiler Committee conducted a study of Finnish recovery boiler characteristics and their operation
- This study is now updated by the data from 2018



#### CHANGES IN RECOVERY BOILERS

## Changes in # of boilers

Laminating Papers	1957		Kotkamills	1959
Kymi SK1	1963		Sunila SK10	1965
Sunila SK10	1965	Kymi SK3 2008	Sunila SK11	1988
Kemijärvi	1968	Kemijärvi closed	Kemi Stora Enso	1980
Kymi SK2	1976		Kenn, Stora Enso	1007
Kemi, Stora Enso	1977		Imatra SK5	1987
Kaskinen	1977	Kaskinen closed	Varkaus	1988
Varkaus	1980		KemiB	1990
Äänekoski	1985	Aänekoski 2017	Kaukas	1991
Kaukopää SK5	1987			1001
Sunila SK11	1988		Oulu	1991
Oulu	1988		Imatra SK6	1992
Kemi, Botnia	1990		Enocell	1992
Kaukas	1991		Danma	1006
Enocell	1992		Kauma	1990
Kaukopää SK6	1992		Joutseno	1998
Rauma	1996		Wisa	2004
Joutseno	1998		Kymi	2008
Wisaforest	2004		Äänekoski	2017
19 k	pl		16 k	cpl

## Capacity 2004 to 2018 +16%



#### Now three recovery boilers that can do +5000 tds/d

#### Age of boilers ~30 years





## LIQUOR FIRING



## More liquor fired



Half of the liquor fired at or over 20  $tds/m^2$ 

#### Bottom loading has increased



More heat released from black liquor per bottom area

#### Liquor HHV decreased



Heating value decreased about 0.3 MJ/kgds or 2%

#### Liquor ds has increased



Dry solids increased about 1%



#### AIR SYSTEMS & SPRAYING

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#### More tertiary+ – less primary



#### Note – modern spraying



#### Liquor temperatures similar



#### Liquor pressures similar





#### **EMISSIONS TO AIR**

#### Mill NOx



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Recovery boiler NOx



#### Recovery boiler SO<sub>2</sub>



All boilers report low sulfur emissions (2004 one boiler ~100)

#### Recovery boiler dust



#### Conclusions

- Bigger boilers firing
- lower heating value liquor at
- higher dry solids
- with higher furnace loading
- due to lower primary air and
- more tertiary and quaternary air
- and maintaining low emissions



