



NTNU/XUAT Postgraduate course 21.05.02-31.05.02:  
Wastewater as a resource

# WATER RESOURCES AND WATER TREATMENT IN SCANDINAVIA

# MAP OF SCANDINAVIA

Scandinavia consists of the countries :

- Norway
- Sweden
- Denmark

The Nordic countries also includes :

- Finland
- Iceland

The countries are situated far north (55-70 °N), but the *Gulf stream* gives a pleasant climate



# GENERAL CHARACTERISTICS OF SCANDIN. COUNTRIES

	Norway (Japan)	Sweden	Denmark
Population	4,3 mill (125)	~ 8,7 mill	~ 5.3 mill
Area (10 <sup>3</sup> km <sup>2</sup> )	324 (400)	450	43
Pop. Density (cap/km <sup>2</sup> )	13 (325)	19	123
Topography	Mountainous, very long coast line	Large low-land area, Large woods	Very flat
Rivers	Many medium and large-sized	Many medium and large-sized	Very few - small sized
Lakes	Many - most small and medium sized	Many - some large sized	Very few - very small and shallow
Fjords	Many - very long and very deep	Few and small - however Baltic Sea	Very few - wide and shallow
Important industries	Oil, fishing, pulp and paper, metallurgi (Al)	Pulp and paper, car, mining	Food industries

# DRINKING WATER SITUATION IN THE SCANDINAVIAN COUNTRIES

	Norway	Sweden	Denmark
Drinking water			
Surface water	90 %	50 %	1 %
Ground water	10 %	50 % (25 % infiltr.)	99 %
Typical drinking water characteristics	Humic substances, very soft, low alkalinity, low pH	The same but also high Ca, Fe and Mn in many waters	High hardness, high Fe/Mn, nitrate, pesticide
Typical drinking water treatment	HS removal, corrosion control, disinfection	Turbidity and HS-removal, corrosion control, disinfection	Fe/Mn-removal, disinfection
Dominating drinking water treatment methods	HS:Coagulation/-direct filtration, membrane filtr., Ca/CO <sub>2</sub> -addition, Chlorination or UV	Traditional coagulation/flocc./sedim./filtration, Ca/CO <sub>2</sub> -addition, Chlorination	Aeration, Fe/Mn-precipitation, chlorination
Water consumption	~ 250 l/cap·d	~ 150 l/cap·d	~ 150 l/cap·d

# DRINKING WATER SITUATION II

	Norway	Sweden	Denmark
No of water works	1600	2100	2900
Serving (% of popul)	77 %	89 %	92 %
Private wells	23 %	11 %	8 %
Water supply network	34.500 km	66.100 km	-
Iron/Steel	39 %	58 %	36 %
PVC/PE/GUP	48 %	35 %	48 %
Asbestos	9 %		8 %
Other	4 %	7 %	8 %
Cost	1100 NOK/inhb.yr 15.700 yen/ihb.yr		
Consumer cost	5 NOK/m <sup>3</sup> 67 yen/m <sup>3</sup>		7 DKK/m <sup>3</sup> 110 yen/m <sup>3</sup>
Energy consumption			0,4 kWh/m <sup>3</sup>

# WASTEWATER SITUATION IN THE SCANDINAVIAN COUNTRIES

	Norway	Sweden	Denmark
Wastewater effl. stand.			
BOD	10 - 20	10 - 20	10 - 20
N	70 % removal	8 - 12	8
P	0,3 - 0,8	0,3 - 0,5	1,0
Typical treatment plant	Many chemical plants Biological/chemical, many biofilm plants	Biol./chemical, many Activ. sludge plants, pre- or post precip.	Biol./chem.. mostly activ. sludge, bio. P- rem. w/simult. precip.
Size of plant	Many small - 85 % < 2000 pe, < 5 plants > 100.000	Many medium-sized 10 - 50.000 pe, > 20 > 100.000 pe	Many medium-sized 10 - 50.000 pe, > 20 > 100.000 pe
Sludge disposal	~ 50 % to agricult. ~ 10 % to compost ~ 30 % to landfill	~ 50 % to agricult. ~ 30 % to landfill ~ 10 % incineration	~ 40 % to agricult. ~ 20 % to landfill ~ 30 % incineration
Effluent disposal			
Fresh water	~ 20 %	~ 40 %	~ 40 %
Coastal water	~ 80 %	~ 60 %	~ 60 %

# USE OF SLUDGE IN AGRICULTURE

	Norway	Sweden	Denmark	EU
Max value heavy metal				
Pb (mg/kg TS)	80	100 (25)	120	750-1200
Cd	2	1,75 (0,75)	0,8 (0,4)	20-40
Cr	100	100 (40)	100	1000-1500
Cu	650	600 (300)	1000	1000-1750
Hg	3	2,5 (1,5)	0,8	16-25
Ni	50	50 (25)	30	300-400
Zn	800	800 (600)	4000	2500-4000
Max supply (g/ha/yr)				
Pb	160	25	840	
Cd	4	0,75	2,8	
Cu	200	300	7000	
Cr	200	40	700	
Hg	6	1,5	5,6	
Ni	100	25	210	
Zn	1600	600	28000	
Max supply (tonTS/ha/yr)	2	-	7	-
Sludge treatm. requirem.				
Stabilization,	Yes	No	No	No
hygienization	Yes	No	Yes	No