SNAP CODE: **040604**

SOURCE ACTIVITY TITLE: **PROCESSES IN WOOD, PAPER PULP, FOOD, DRINK AND OTHER INDUSTRIES**
Paper Pulp
(Neutral Sulphite Semi-Chemical Process)

NOSE CODE: **105.07.03**

NFR CODE: **2 D 1**

1 ACTIVITIES INCLUDED

Pulp and paper production has three major processing steps: pulping, bleaching, and paper production. The type of pulping and the amount of bleaching used depend on the nature of the feedstock and the desired qualities of the end product. Neutral sulphite semi-chemical pulping (NSSC) is one of the chemical pulping processes that can be used. It involves partial delignification of hardwood feedstock using a buffered sodium sulphite solution, with completion of the pulping process by mechanical means. NSSC pulps are used in corrugating media and in certain writing and printing papers.

Not all neutral-sulphite pulping and related processes that could result in the emission of significant amounts of NMVOC, SOx, particulates, NOx and CO are included under SNAP code 040603. Other significant sources are listed in Table 1.

Table 1: Other Relevant SNAP Codes for Paper Pulping - Neutral Sulphite Semi-Chemical Process

Source	SNAP CODE
Combustion in Boilers	03 01 xx
Paper-mill industry (drying processes)	03 03 21
Waste water treatment	09 01 xx

In addition to more conventional fuels such as wood/bark, coal, oil and natural gas, boilers at pulp and paper mills may combust noncondensable gases, small quantities of wastewater treatment sludge (from both virgin pulp and recycle operations), nonrecyclable recovered paper, tire-derived fuel, old corrugated container materials etc. (NCASI 1993)

It is assumed that these non-conventional fuels that are combusted in boilers will be covered somewhere in SNAP group 03.

This section is under review by Scandinavian participants. Changes are anticipated as more information becomes available. These will be incorporated in a future edition of this manual.

2 CONTRIBUTIONS TO TOTAL EMISSIONS

Emissions inventoried from neutral sulphite semi-chemical pulp and paper processes are summarized in Table 2.

Table 2: Contribution to total emissions of the CORINAIR90 inventory (*28 countries*)

Source-activity	**SNAP-code**	**Contribution to total emissions [%]**							
		SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	NH_3
Paper Pulp (Neurtral Sulphite Semi-Chem. Proc.)	040604	0.1	-	-	-	-	-	-	-

0 = emissions are reported, but the exact value is below the rounding limit (0.1 per cent)
- = no emissions are reported

3 GENERAL

3.1 Description

In the NSSC process, a cooking liquor is used under high temperature and pressure to chemically dissolve the lignin that binds the cellulose fibres of the wood together. The main cooking agent is sodium sulphite, buffered with sodium bicarbonate to maintain a neutral solution. This prevents alkalinity and acidity from degrading the hemicelluloses in the pulp, but also retards delignification. Thus after blowing from the digester, the pulping is completed using mechanical disc refiners. The pulp is then cleaned and thickened and dried for sale as market pulp or further processed into paper products on-site. Spent liquor handling methods vary widely. Options include disposal, recovery of heat and/or chemicals or transfer of the spent liquor to conventional kraft recovery mills for cross recovery.

3.2 Definitions

Blowing - evacuation of a vessel (the digester) under pressure.

3.3 Techniques

The main process steps involved in neutral sulphite semi-chemical pulping are briefly described below. It should be noted that significant emission sources for this process are inventoried under separate SNAP codes (see section 1).

Digestion Digestion is carried out under high pressure and high temperature, in either batch mode or continuous digesters, in the presence of a buffered sodium sulphite cooking solution (liquor). Delignification occurs by lignin sulphonation and hydrolysis. Buffering, usually by the addition of sodium carbonate to the cooking liquor, retards the delignification process. When about half the lignin is dissolved. delignification tends to slow down considerably. The pulp is blown to a blow pit at this point and dewatered. Pulping is completed using mechanical disc refiners. This method achieves yields as high as 60 to 80 percent, much higher than the 50 to 55 percent yields for other chemical processes.

The pulp may then be dried for sale as market pulp or further refined, cleaned and made into paper on-site. Most of the pulp used for the manufacture of printing products is bleached.

Bleaching Bleaching chemical pulps is generally complex and uses several chlorine-based chemicals. Strictly speaking, bleaching is part of the paper making process, as opposed to pulping, but has been included under this SNAP code for complete coverage of the pulp and paper industry as a whole.

Chemical Recovery In some NSSC processes, chemical recovery is not practiced. In other cases, NSSC spent liquor is delivered directly to a conventional kraft recovery system, a technique known as cross recovery. This is only feasible when a kraft mill is close by and where chemical losses in the kraft mill warrant cross recovery.

In some cases, however, chemical recovery is practiced on site. Fluidized-bed reactors are used to combust the spent liquors after preconcentration in multiple effect evaporators to 30-35% solids. The inorganic chemicals and sodium organic salts are chiefly oxidized to sodium sulphate and sodium carbonate pellets. This matter is removed from the reactor and can be sold to a kraft mill for use as its chemical make-up, if a suitable market exists.

Acid Preparation Plant
In an acid plant, sulphur is normally burned in a rotary or spray burner. The gas produced is then cooled by heat exchangers and a water spray and passed to an absorber tower.

3.4 Emissions and Controls

Particulate emissions are a only potential problem when a fluidized bed reactor is used for chemical recovery. However, particulate controls are usually installed to improve chemical recovery rates, since the particulate is mainly sodium sulphate and sodium carbonate.

Absorbing towers, digester/blow tank systems and the recovery furnace are the main sources of SO_2. These sources are normally controlled with scrubbers.

The fluid bed reactor has been reported as a minor source of NOx and VOCs. Bleaching plants may also be minor sources of VOCs.

4 SIMPLER METHODOLOGY

Due to a lack of emission factors, it is not possible to recommend a simple inventory methodology for neutral sulphite semi-chemical plants at this time.

5 DETAILED METHODOLOGY

The preferred methodology would involve the measurement of emissions from each plant to develop site-specific emission factors for all potentially significant sources. These emission factors could then be used to calculate emissions, as required, until such time as the process

or emissions controls are significantly changed. At that point, new site-specific emission factors should be derived based on testing.

6 RELEVANT ACTIVITY STATISTICS

Emission factors for this sector would normally be based on tonnes of air dried pulp.

7 POINT SOURCE CRITERIA

A recent report (Stanley 1993) indicated that one semi-chemical mill emitted 24 Mg of NMVOC. Unfortunately, no production information was supplied for this facility. However, this would seem to indicate that NSSC facilities should be inventoried as point sources if plant specific data are available.

8 EMISSION FACTORS, QUALITY CODES AND REFERENCES

There is a very limited data base available for NSSC. No particulate or SO_2 emission factors were found. Available NOx and VOC emission factors (kg/tonne air dried pulp) are summarized in Table 3.

Table 3: NOx and VOC Emission Factors for Neutral Sulphite Pulping (kg/tonne air dried pulp)

Source	NOx	VOC	Reference
Sulphur burners/absorbers	0.0*	0.0**	Stockton and Stelling n.d.
Digester/dump tank/blow pit	0.0*		Stockton and Stelling n.d.
Evaporator	0.0*		Stockton and Stelling n.d.
Fluid bed reactor	0.5***	0.1***	Stockton and Stelling n.d.
Bleach Plant		0.05[+]	NCASI 1993

* No NOx because of low temperature.
** No apparent source of VOCs.
*** Factor transferred from kraft mill processes.
[+] This is on an as carbon basis. Range: 0.004 - 0.14 kgg/tonne air dried pulp. Based on tests of one to eleven vents at thirteen sources. The type of pulp is not specified. It was indicated that it was NMVOC. (NCASI 1993).

With the exception of the bleach plant emission factor, all factors would have a quality rating of E.

9 SPECIES PROFILES

10 UNCERTAINTY ESTIMATES

11 WEAKEST ASPECTS/PRIORITY AREAS FOR IMPROVEMENT IN CURRENT METHODOLOGY

An emission factor compilation should be done for this sector so that a simpler methodology can be recommended. This database must be detailed enough to accommodate the wide variety of processes that may be present at one of these facilities.

12 SPATIAL DISAGGREGATION CRITERIA FOR AREA SOURCES

Neutral sulphite semi-chemical processes are inventoried as point sources.

13 TEMPORAL DISAGGREGATION CRITERIA

Neutral sulphite semi-chemical pulping facilities normally run year-round. It may be assumed that emissions occur uniformly over diurnal and annual cycles, barring unusual operational disruptions.

14 ADDITIONAL COMMENTS

15 SUPPLEMENTARY DOCUMENTS

16 VERIFICATION PROCEDURES

17 REFERENCES

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18 BIBLIOGRAPHY

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20 POINT OF ENQUIRY

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