RECOVERY OF NICKEL FROM SPENT NICKEL CATALYST

by: HAZIMAH, A H; OOI, T L; CHEAH, K Y and SALMIAH, A

JUNE 2003

212

MPOB TT No. 198

MPOB INFORMATION SERIES ISSN 1511-7871

Spent nickel catalyst is generated by various chemical and industrial processes particularly in hydrogenation of natural oils and fats. The spent catalyst generated by the Malaysian palm oil industry usually comes from two processes: hydrogenation of soft oils to fat or hydrogenation of fatty acids of high iodine value (IV) to fatty acids of low IV. The average nickel content in the spent catalyst was found to be in the range of 10%-15%. The residual fatty matter (fatty acid) was up to about 55% and the rest were inorganic or support materials *(Table 1)*. The inorganics consist mainly of silica, alumina, bleaching earth and filter aids.

TABLE 1. COMPOSITION OF SPENT NICKEL CATALYST

	Nickel	Residual fat	Inorganic matter
Percentage	10-15	35-55	25-40

SCHEDULED WASTE

The spent nickel catalyst is classified as a scheduled waste by the Department of Environment (DOE). Scheduled waste means any waste falling within the category of wastes listed in the First Schedule of the Environmental Quality (Scheduled Wastes) Regulations 1989 which came into force on 1 May 1989. In the First Schedule, spent nickel catalyst comes under the schedule waste from non-specific sources (N081) which is about spent organometallic compounds or residues of organometallic compounds. The disposal and treatment of scheduled wastes like spent nickel catalyst has to be carried out at prescribed premises only. Currently, Kualiti Alam Waste Management Centre is the only body handling these wastes. A certain amount of charges are imposed for every tonne of waste disposed of. The charges are listed below:

1. Landfill Disposal: RM 500.
2. Incineration: RM 810-RM 3600.
3. Physical / Chemical treatment: RM 1440-RM 3780.
4. Solidification: RM 770-RM 810.

(Source: New Sunday Times, 23 December 2001)

RECOVERY PROCESS

Prior to the recovery process, the spent catalyst was digested in Kjeldahl Digestive System to separate the metallic, organic and inorganic fractions. The residual fat could also be recovered by Soxhlet extraction. The nickel metal is then adsorbed by suitable reagents under mild conditions. The amount of nickel left in experimental solution could be monitored by UV visible or AA spectrophotometer.

ECONOMIC VIABILITY

A survey conducted has indicated that the amount of spent nickel catalyst generated differ considerably. Those from the refineries are more oily than those generated by the fatty acid plants. However, their compositions are within those figures stated in *Table 1.*

The recovery process developed by MPOB is simple and could easily be adopted by a new company. The economic assessment for an interested party is shown in *Table 2*, assuming that the price of spent catalyst is RM 500 t^{-1} from oleochemical companies which generate about 150 t yr^{-1} (from the survey):

The total cost to set up the required plant = a1 + a2 + a3 + a4 +a5 = RM 13.09 million.
The income from the recovered nickel = RM 90 million (b).

It is anticipated that the proposed plant can run two batches a day for 300 days a year if the required amount of spent nickel catalyst could be obtained.

TABLE 2. ECONOMIC ASSESSMENT OF THE PROCESS

	Price (RM)	Total cost (RM) from 150 t SNC
Cost of SNC	500 t^{-1}	75 000 (a1)
Transportation	100 t^{-1}	15 000 (a2)
Recovered nickel (100 kg t^{-1})	6 000 kg^{-1}	90 000 000 (b)
Processing cost	60 000 t^{-1}	9 000 000 (a3)
Cost of equipment / plant		1 000 000 (a4)
Cost of a factory		3 000 000 (a5)

Figure 1.

CONCLUSION

The study on the spent nickel catalyst has shown that the useful components in the spent catalyst could be recovered easily. The recovery process developed is simple and can be carried out under mild conditions. The study also promotes the concept of reduce, recycle and reuse.

ACKNOWLEDGEMENT

The authors would like to acknowledge the assistance of Ms Sapiah Hashim and the companies which participated in the survey and sharing some of the information with us.

For more information kindly contact:

Director-General
MPOB
P. O. Box 10620
50720 Kuala Lumpur, Malaysia.
Tel: 03-89259155, 89259775,
Website: http: //mpob. gov. my
Telefax: 03-89259446