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PREPARATION OF NICKEL SALTS FROM SPENT NICKEL CATALYST

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The spent nickel catalyst (100 kg) was processed to leach out nickel (8kg) as nickel sulphate (38 kg) which is converted into nickel carbonate (16 kg) and subsequently into nickel formate (24 kg). The nickel formate is crystallized, dried, ground and sieved to 200 mesh prior to the activation of nickel into embedded nickel catalyst.

Key words: Nickel formate, Embedded, Poisoning.

Introduction

Activated nickel catalyst for the conversion of vegetable oil into fat can be prepared either from nickel metal [1] or its salts [2] such as sulphate, nitrate, carbonate and formate. Therefore nickel can be recovered from spent catalyst as sulphate [3] and processed to form an embedded nickel catalyst. In this study fat free waste material is treated with sulphuric acid to leach out nickel as nickel sulphate. Subsequent treatment with sodium carbonate then formic acid converts sulphate into carbonate and formate [4] salts respectively. The decomposition of nickel formate is carried out is a specially designed pilot plant [5] in the presence of fat and hydrogen gas to get acti vated embedded nickel catalyst.

Experimental

Formation of nickel carbonate. A purified solution of nickel sulphate (38 kg) was taken in stainless steel reaction vessel. It was heated and stirred with saturated sodium carbonate (27 kg) solution for $1\frac{1}{2}$ hrs. to obtain nickel carbonate (16 kg) which was further washed and dried.

Preparation of nickel formate. The nickel carbonate (16kg) was suspended in water and heated in a stainless steel open pan with conc. formic acid (13 kg). The resulting solution was concentrated and cooled to crystalize out nickel formate (24 kg) which was separated by filtration.

Drying and sieving of nickel formate. The dryer (Fig.1) was used for the drying of nickel formate at 105°. The

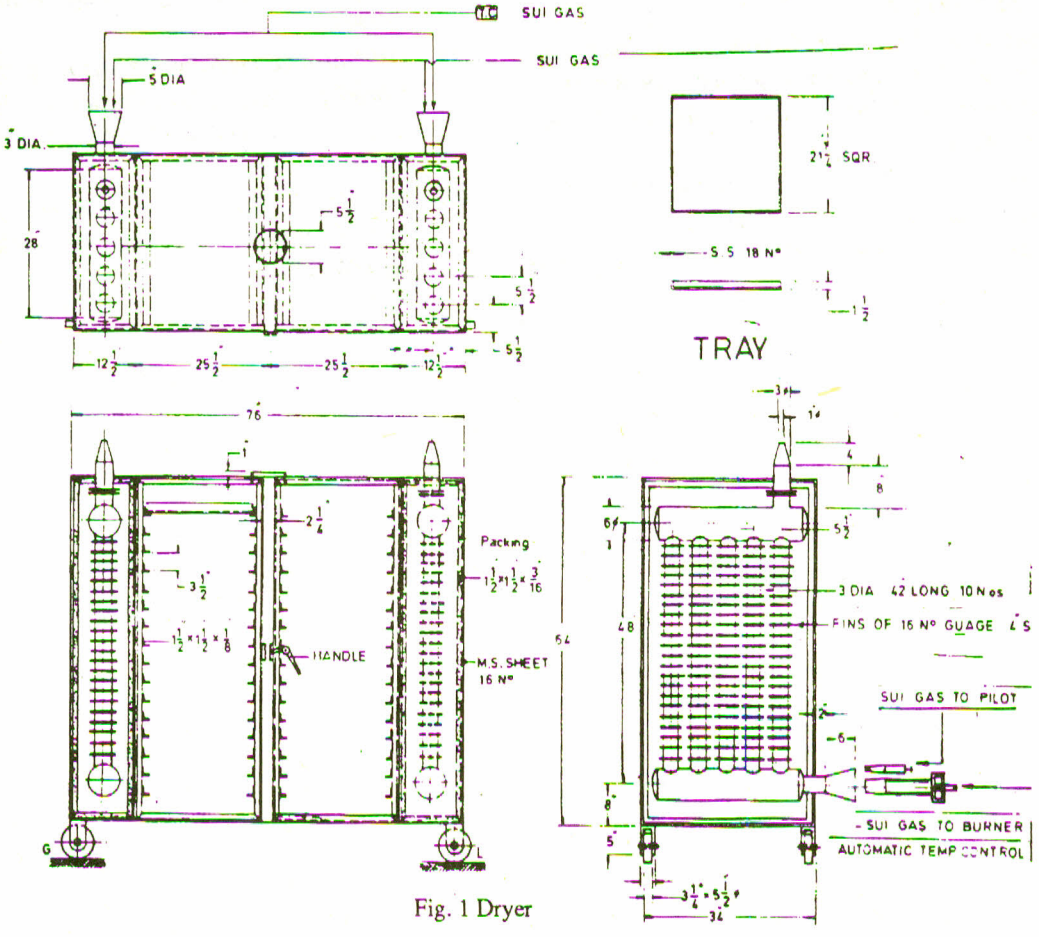
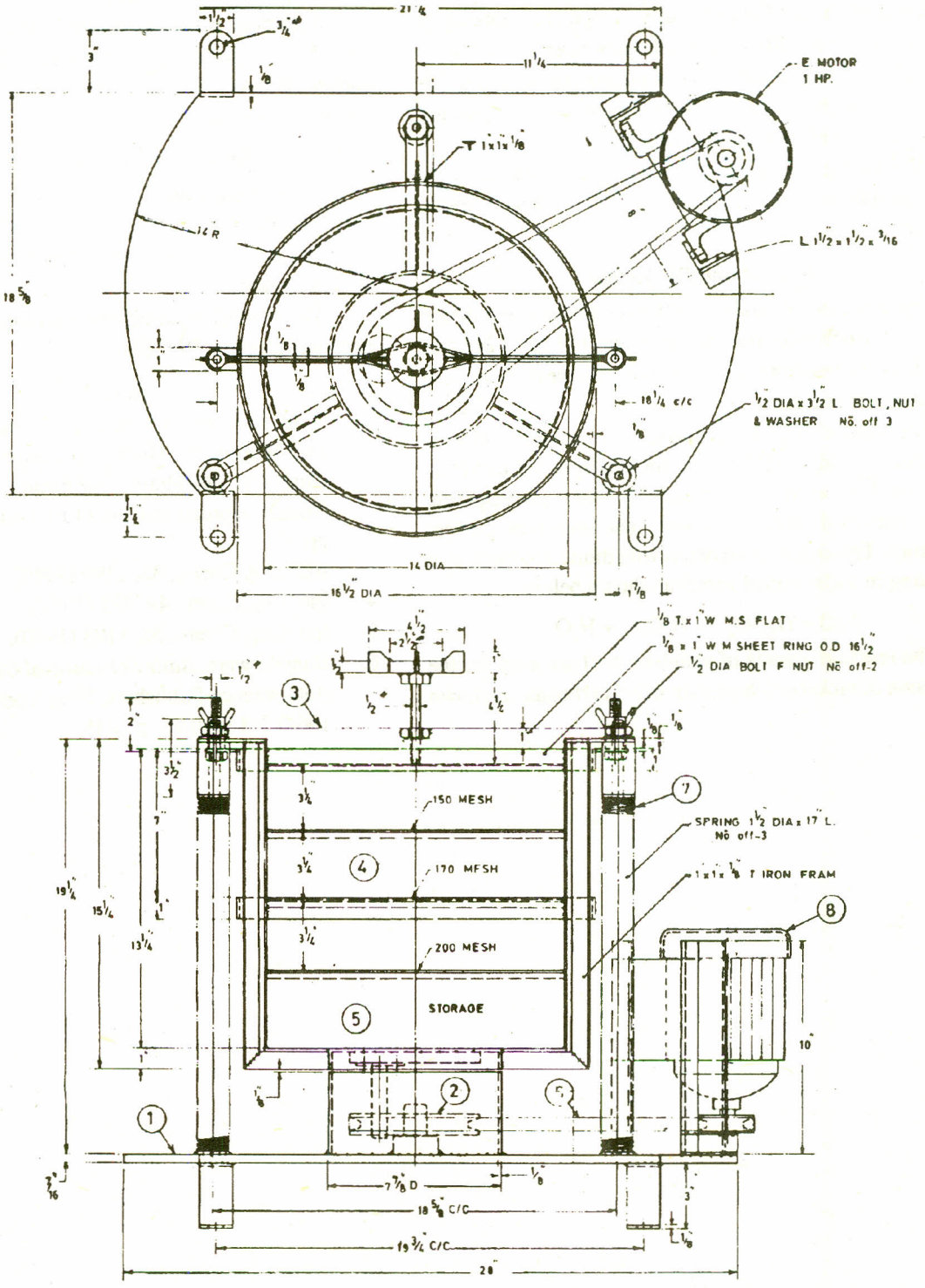


Fig. 1 Dryer



S.N.	DESCRIPTION	MAT.	QTY
8.	ELECTRIC MOTOR	H.P.	ONE
7.	SPRING	SPR. STL.	THREE
6.	BELT	RUBBER	ONE
5.	STORAGE BIN	S.S.SHT	ONE
4.	SEIVES	(150, 170, 200 M)	S.S. THREE
3.	TOP CLAMPING WITH BUTTERFLY NUTS	M.S.	ONE
2.	DRIVING PULLEY	M.S.	ONE
1.	BASE STAND	M.S.	ONE

Fig. 2. Vibrating seive

temperature of the dryer was fixed and controlled automatically by a solenoid valve. The pilot burner helped for working of the main burner or fall of the fixed temperature. The hot air circulates inside the dryer and dries the material by removing moisture through exhausts. The rod mill was used for the grinding of nickel formate after drying.

A vibrating unit of three sieves (Fig.2) was used to get nickel formate having particle size of 200 mesh to facilitate degradation.

Results and Discussion

The spent nickel catalyst 100 kg is processed to produce 8 kg nickel which is further converted into 16 kg and 24 kg of nickel carbonate and formate respectively. So the ratio between these products is 1:2:3.

The mineral acid either nitric acid, sulphuric acid or hydrochloric acid could be used for leaching out nickel as nitrate, sulphate or chloride respectively. The use of sulphuric acid is preferred since its lower cost improves process economics. The nickel oxide reacts with dilute sulphuric acid on heating in a glass lined vessel as shown below:

$$NiO + H_2SO_4 \rightarrow NiSO_4 + H_2O$$

The reaction vessels of stainless steel are used for the conversion of nickel sulphate into nickel carbonate as shown below:

$$NiSO_4.7H_2O + Na_2CO_3 \rightarrow NiCO_3 + Na_2SO_4 + H_2O$$

A through washing is essential to remove compound [6] as sodium sulphate which otherwise poison the catalyst. The nickel carbonate is transformed into nickel formate via the following reaction:-

$$NiCO_3 + 2HCOO \xrightarrow{+H_2O} (HCOO)_2Ni.2H_2O + CO_2$$

Nickel formate after drying and grinding is sieved through 150, 170 and 200 mesh to get material of the required particle size. So the fabrication cost is reduced by designing such type of sieving unit.

The wet technique has been explored for the production of nickel catalyst (Part-III).

References

1. W.D. Richardson, Chem. Met. Eng., **22,** 793 (1920).
2. Paul H. Emmett, Hydrogenation and Dehydrogenation. *Catalysis*, (Reinhold Publishing Corporation, New York, Chapman and Hall Ltd. London, 1955) Vol. III, pp 20.
3. Ind. Eng. Chem., **32,** 1199 (1940).
4. Ind. Eng.Chem., **44,** 985 (1952).
5. Ind. Eng. Chem., **32,** 1193 (1940).
6. Daniel Swern, *Bailey's Industrial Oil and Fat Products*, (Interscience Publishers, New York, London, Sydney, 1964) 3rd Edition, pp.835.