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REGENERATION OF NICKEL CATALYST

M.A. RAIE AND MANZOOR AHMAD

PCSIR Laboratories Complex, Lahore, Pakistan

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The stainless steel activation unit is used for the degradation of nickel formate at 230° by automatically controlled electric heating system. The hydrogen gas is passed through during the process. The embedded nickel catalyst contains nickel (21.0%), fat (67.0%) and diatomaceous earth (12.0%).

Key words: Degradation, Transformation, Pyrophoric.

Introduction

Catalysts such as embedded [1] supported, raney [2], promoted nickel [3,4] and metallic stearate [5] are used in industries based on oils and fats. They are used for the hydrogenation of oils, unsaturated fatty acids and oxidation [6] of hydrocarbons to produce fatty acids for toilet soap, laundry soap, margarine, shortening and allied products. The nickel catalyst used for vanaspati ghee industry is imported by spending 20 million rupees annually. The nickel catalyst gradually deactivates [7] into a waste material. Unfortunately nickel is not available in this country and thus investigation into the recovery of nickel from the spent catalyst is useful. For the first time in Pakistan, attempts have been made to produce embedded nickel catalyst from the waste material.

One technique is first to extract fat from the spent nickel and then to leach out the nickel as sulphate. The sulphate salt can be converted to formate and the nickel can then be reduced to metal in the presence of hydrogen gas and fat. The embedded catalyst is used for the transformation of oils into vanaspati ghee in the presence of hydrogen gas. This process simply converts unsaturated into saturated fatty acids attached to glycerol which are known as triglycerides. The specific saturation of edible oils is carried out by nickel catalyst. Selective hydrogenation [8]means less conversion of oleic acid to stearic acid as compared to linoleic acid to oleic acid, also comparatively less percentage of isomeric acid like isoleic acid under the same set up of conditions is produced. The selective process of hydrogenation not only converts the liquid oil to semi solid fat but also improves the colour of fat and enhances the stability of fat.

Experimental

The preparation of nickel catalyst from nickel formate is carried out in a specially locally designed and fabricated stainless steel activation unit of capacity of 150 kg/batch. The activation unit is electrically heated with thermocouple and thermostat controlling temperature and contained saturated fat (100.5 Kg) and nickel formate (98.7 Kg). Hydrogen gas was bubbled through the mixture by a stainless steel tube when the temperature reached 150°. The temperature of the mixture was raised at a rate of (0.5°/min) until 230° was reached and allowed to stand for 1 hr. After this the material was cooled to 150° with bubbling of hydrogen gas. Later on diatomaceous earth (18.0 Kg) was mixed thoroughly with the degraded material. The nickel catalyst finally was taken out in stainless steel trays to make strips of thickness1/8" on cooling at room temperature. One batch of embedded catalyst was prepared in 4 hrs.

Results and Discussion

100 Kg of activated nickel catalyst contains 67 Kg, 21 Kg and 12 Kg of fat, nickel and diatomaceous earth respectively. The diatomaceous earth helps in filtration process.

There are two techniques to transform nickel carbonate into activated nickel and are known as wet and dry method. In the latter, nickel carbonate is precipitated on diatomaceous earth and can be degraded into activated nickel at a temperature of around 510° in the presence of hydrogen gas according to the following reaction:

$$NiCO_3 + H_2 \text{-----} Ni + CO_2 + H_2O$$

The activated nickel becomes pyrophoric due to active spots or unsaturated nickel atoms. So strict measures and specially designed equipment must be used to avoid fire. Industrially this means a more expensive process, so the alternative wet method is used for the preparation of nickel catalyst.

In this study the embedded nickel catalyst is prepared by the degradation of nickel formate at a temperature of 230° in the presence of hydrogen or nitrogen gas and fat as shown below:

$$Ni\,(OOCH)_2\,2H_2O \text{----} Ni + 2CO_2 + 2H_2O + H_2$$

Fumes of CO_2, H_2 and H_2O are produced at very high rate, therefore, a fume hood is placed above the activation unit (Fig 1.). The attechment of oxygen to

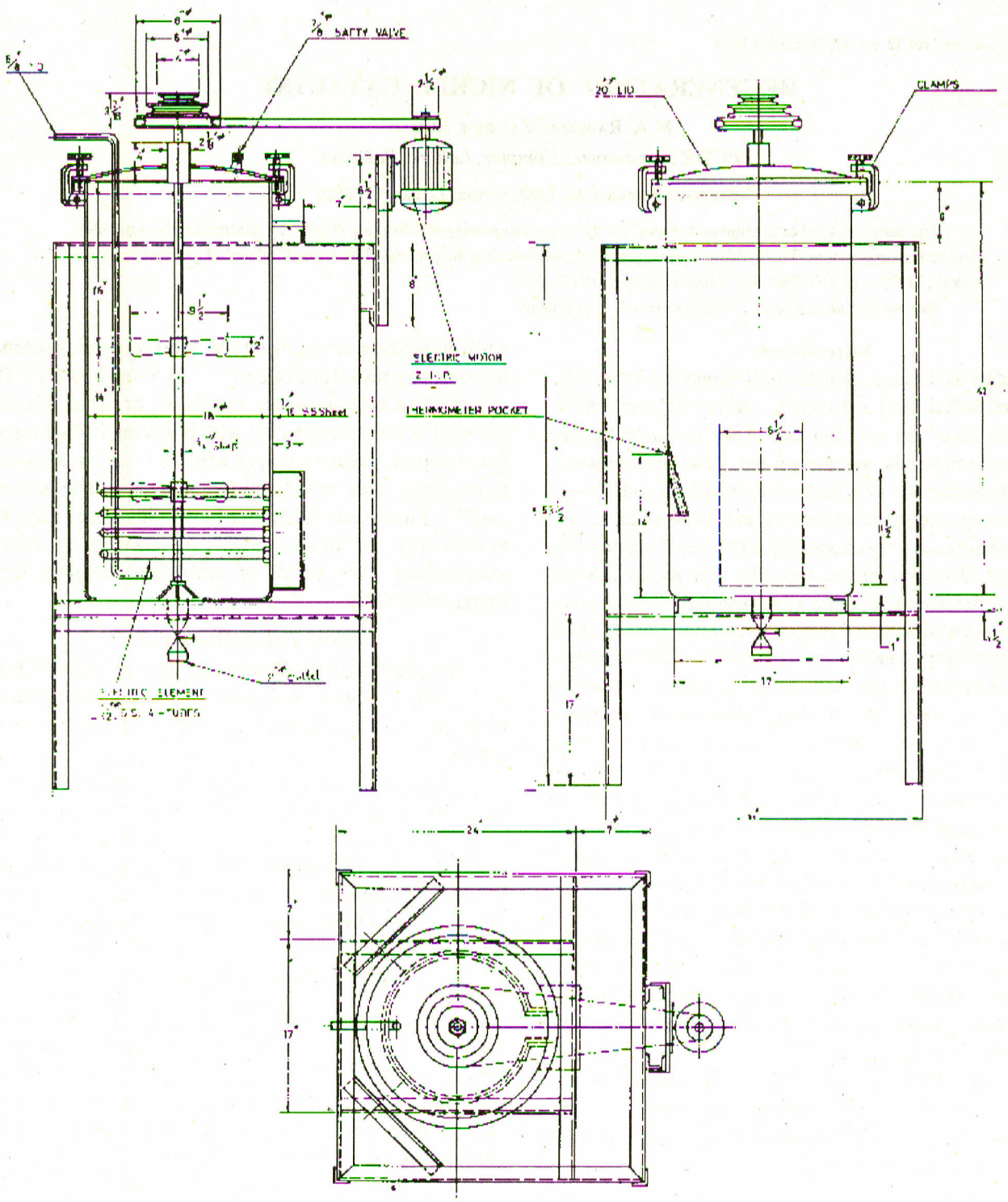

Fig 1. Activation plant

active spots makes the catalyst inactive, therefore, the use of fat to make contact with active spot is essential to maintain the activity of catalyst for a certain period.

Usually the nickel catalyst is available in the form of pellets, flakes or strips. The hydrogenation of oil is carried out in the presence of nickel catalyst at a temperature of 180° and thus the embedded catalyst in any shape is melted and uniformly mixed with the oil by stirring, therefore, the original shape of the catalyst is not important.

The regenerated nickel catalyst [9] was evaluated by industrial units of Ghee Corporation of Pakistan (Part-IV).

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