A Continuous Catalyzer Reducing Furnace

By HERBERT SIECK
SIECK & DRUCKER, INC., CHICAGO, ILL.

Abstract

A Continuous Catalyzer Reducing Furnace is described, in which the Furnace consists of a rotating steel tube, the catalyst being forwarded along inside of this tube by means of a helical conveyor ribbon welded to the inside of the tube. Means are provided for feeding in the unreduced catalyzer at a predetermined rate and also for discharging the finished catalyst into oil without coming into contact with air. The flow of the reducing gas is countercurrent to that of the catalyst.

THE Furnace, in which the calcining and reducing takes place, is a steel tube, 10″ in diameter, made up in three sections and having a total length of about 20 feet. A helical ribbon conveyor, 2″ wide, is welded to the inside of the tube and at intervals scoops or vanes, also 2″ wide, are welded between the conveyor flights. The ribbon conveyor and these scoops or vanes are therefore permanently fastened to the tube and rotate with it.

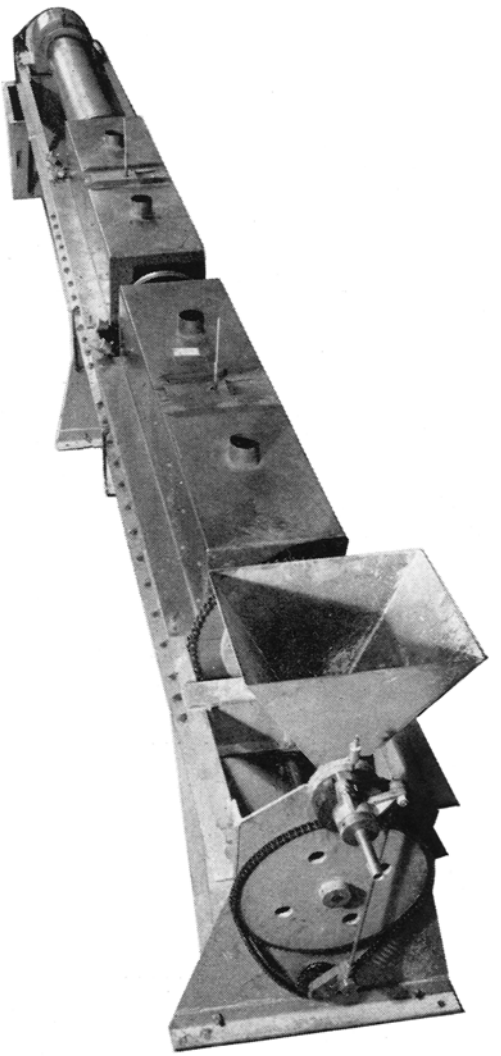
Two sections of the tube are enclosed in a housing lined with refractory brick, well insulated and provided with gas burners for heating the tube. The third section, which acts as a cooling zone, is left bare. The tube is driven from the feed end and makes one-half revolution per minute, at which speed it will require one and one-half hours' time for a particle of catalyst to pass from the feed to the discharge end.

Operating temperatures are determined by means of thermometers inserted in bronze blocks which ride on top of the reducing tube.

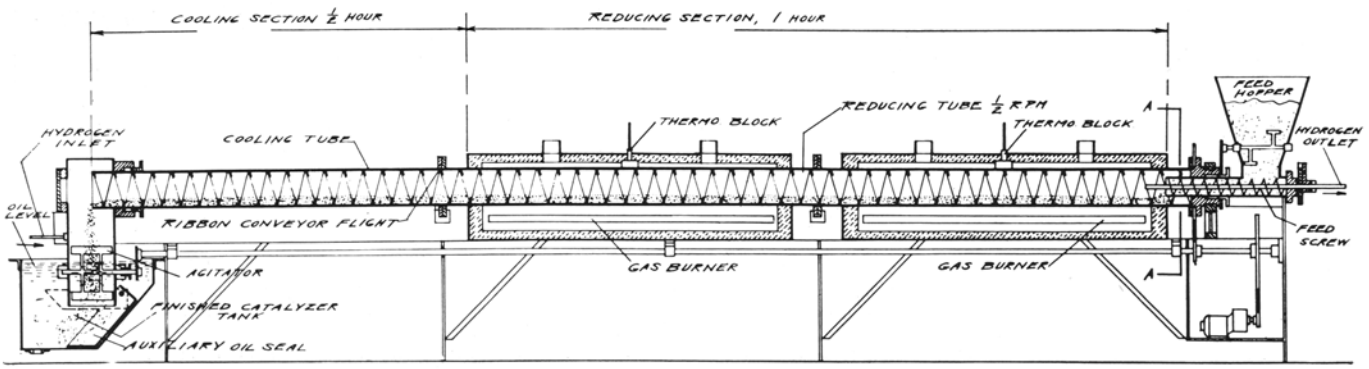
At the feed end is located the feed hopper which is provided with a slowly rotating agitator to prevent the green catalyzer from bridging over the opening to the feed screw. This is a helical conveyor, the shaft of which is a hollow steel tube which serves as an outlet for hydrogen and steam. The feed screw is driven through a ratchet and gear, permitting a wide variation in speed and consequently a wide variation in the amount of green catalyzer fed into the reducing end.

At the discharge end there is provided a closed box or hood into which the reducing tube enters through a stuffing box. This box or hood is open at the lower end, is fitted with a slowly revolving agitator or paddle wheel and an auxiliary oil seal tank which can be raised when the oil and catalyzer are being pumped out of the finished catalyzer tank. This prevents exposure of the finished catalyst to the air while the catalyzer tank is being emptied and until it is again filled with oil.

In operation the feed hopper is filled with dried and ground green catalyst, the finished catalyzer tank is filled with oil, and nitrogen or carbon dioxide run through the equipment to displace the air. Hydrogen gas is then introduced at the discharge end, the reducing tube set in motion, and the gas burners lighted. When the required temperature has been reached the feed screw is started and after one and one-half hours' time finished catalyst will be discharged into the oil in the catalyzer tank.



Feed End of Furnace



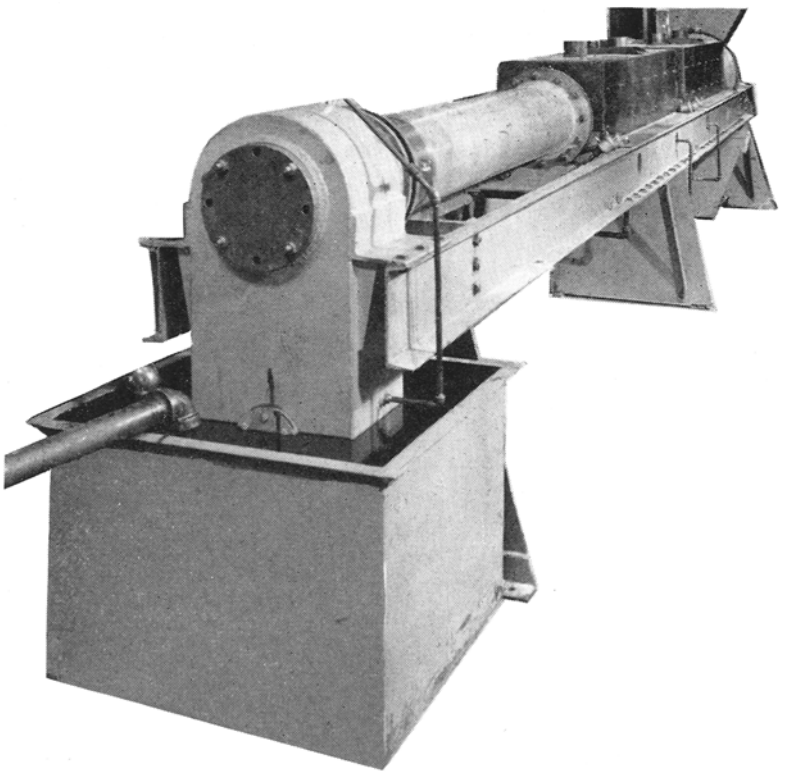
Cross Section of Furnace

Steam and excess hydrogen leave the tube through the hollow shaft of the feed screw. The agitator or paddle wheel at the discharge end continuously works the finished catalyzer into the oil, preventing an accumulation with the possibility of blocking at this end.

When a sufficient quantity of finished catalyzer has been accumulated in the oil in the catalyzer tank the auxiliary oil seal is raised to the position shown in dotted lines and the oil and catalyst pumped out. Fresh oil is added and the auxiliary oil tank dropped. There is therefore no necessity for stopping the reducing operation while the tank is being emptied.

The time of transit of the catalyzer through the reducing tube can be varied by changing the speed of rotation of the tube. The amount of green catalyst fed in and consequently the depth of the catalyzer in the tube can be regulated by changing the speed of rotation of the feed screw. Temperature control is, of course, obtained by the regulating valves on the gas burners.

Inasmuch as the reducing tube is rotating continuously while the burners are lighted there is no overheating of any part of the tube to cause warping or misalignment. An automatic valve shuts off the gas to the burners in case of power failure and consequent stopping of the motor which drives the tube. As the conveyor flights rotate with the tube the sticking or binding which was common with the older type furnaces, in which the conveyor turned inside of a stationary tube, has been entirely eliminated.



Discharge End of Furnace

This furnace produces a very uniform catalyst with lower consumption of labor, heating gas and hydrogen than would be required in an intermittent or batch furnace of the same capacity.

Catalysts for Hydrogenation

By M. H. GWYNN
CONSULTANT
LEONIA, N. J.

Abstract

Heterogeneous catalysts are differentiated with respect to sulphur poisoning, viz. sulphur sensitive, e.g. Ni, and sulphur immune, e.g. MoS_2. Immunity to poisoning is related to temperature, and inversely to catalyst activity. It is stated that nickel catalyst for the selective hydrogenation of cottonseed and like oils should be pure and preferably derived from an unusually active and readily reducible compound of nickel. Three sources of impurities, and the possible relation to promoters of one source in particular, are described. Catalysts are differentiated with respect to the form of the support, viz. powder, impregnate, superficial. The superficial catalyst in stationary form appears best adapted for continuous hydrogenating equipment in the industry.

INTRODUCTION

THE heterogeneous catalytic art emerged from a totally unscientific aspect about 1834, apparently dating back to Faraday's[8] catalytic oxidation work on platinum surfaces. Faraday drew a remarkably simple conclusion from his work, which is underlying to this paper and which is discussed later herein. About a century ago, and shortly after Faraday's work, Berzelius[9] gave catalysis its present nomenclature.

About forty years ago, the art entered a new phase of development with Sabatier's[10] well-known work and the discovery of nickel as a heterogeneous catalyst for hydrogenation. Despite wide industrial development, and recent intensive application by the motor fuel industry, the art still appears to be only in a semi-scientific stage, from which it is not likely to emerge for years to come.

Until that time, any attempt to treat the subject broadly must be rather qualitative and subjective. Because of the many variables involved, some of which are not even generally recognized, the perfection of a catalysis requires much detailed work and careful judgment, with specific attention to the catalyst. The apparent lack of scientific development is probably no fault of those in the art, for the subject is nearly as broad as chemistry itself, and also extends into the science of physics.

There is evidence too that hydrogenation is the elementary chemical reaction. The extensive nature of organic hydrogenations and a general bibliography of the subject is given by Ellis[1]. However, inorganic substances may also be hydrogenated. For example, the hydrogenation of atmospheric N_2 to NH_3 uses more H_2 than the sum total of all other hydrogenations in this country. On the other hand, nickel is a catalyst for a variety of reactions other than hydrogenation, some of which may furnish the clues to the mechanism of catalytic