



APPLICATION NOTE

NOTE NO: 98005

EVALUATION OF INCREASE IN THROUGHPUT USING A CATALYST

Process Optimisation
Improvement In Yield
Reduction In Batch Time

DESCRIPTION

An esterification reaction is carried out at 40°C in a stirred vessel by adding an organic anhydride to an alcohol. The reaction is mildly exothermic and rather slow. The anhydride is added over a period of 100 minutes, but the reaction takes nearly 12 hours for completion.

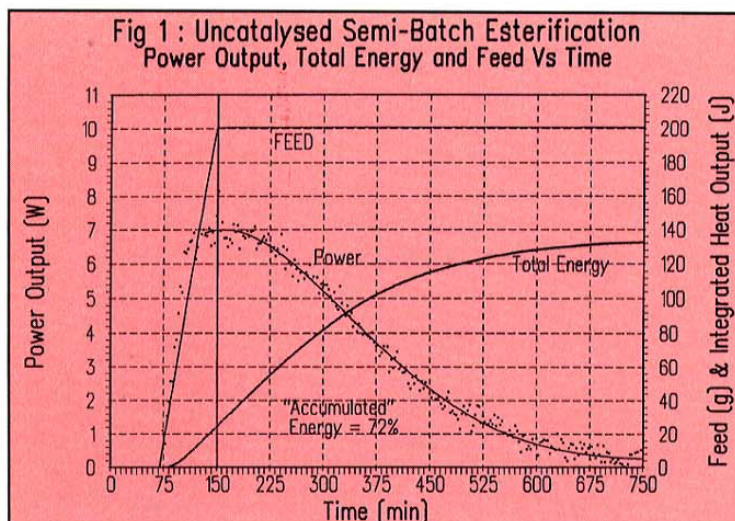
The objective was to test the effectiveness of an acid catalyst in reducing the batch time and whether the cooling system on a full scale reactor would be able to cope with the increased power output.

EXPERIMENT1: BASECASE

The traditional method of esterification was evaluated using power compensation calorimetry and the results are shown in figure 1. The heat output rate (measured in W) is seen to increase as anhydride is dosed. This peaks at ~7W and then goes

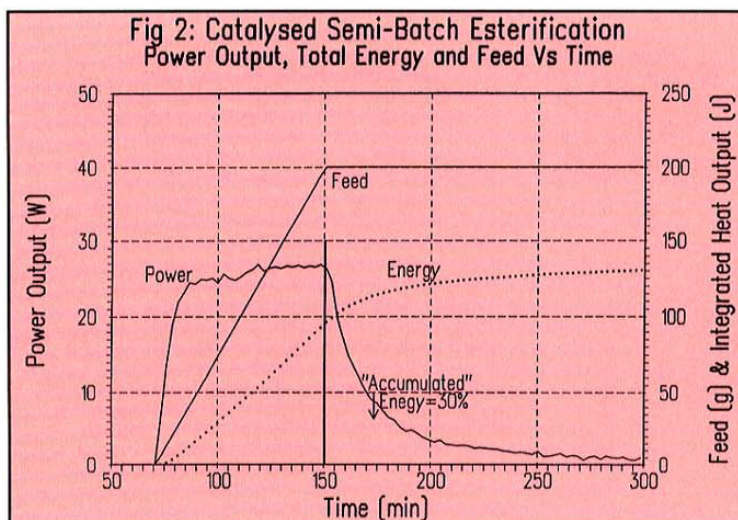
down gradually after the feed is stopped. It takes ~600 minutes after the end of dosing before the power output returns to zero.

This confirms existing plant experience concerning the long batch time.



EXPERIMENT 2: EFFECT OF CATALYST

When anhydride is added to the alcohol containing catalyst at the same rate and at the same temperature, the heat output rate is much larger (see figure 2). The heat output now peaks at ~27W and after dosing is stopped, returns to zero after ~150 minutes.



CONCLUSIONS

(1) The Batch Time

It is clear from only two tests that the batch time can be reduced substantially by use of the catalyst.

The results are as follows :

	Batch Time (mins)
Uncataysed	700
Catalysed	250

(2) Scale-up :cooling duty

When the catalysed reaction is scaled-up, the cooling duty needed will be much greater than for the basecase reaction. Unless there is sufficient cooling capacity, scale-up to full scale should not be attempted.

The following is a comparison of the maximum cooling rates needed on a 2 m³ vessel for the two cases :

	Cooling Duty (kW)
Uncataysed	14
Catalysed	44

(3) Safety Issues

In the basecase reaction, the amount of heat released, after anhydride feed is stopped, was almost three-quarters of the total. This means that about 75% of the anhydride has accumulated in the vessel and then reacts out over a period of about 10 hours. In the event of an operating problem (such as loss of cooling), this large amount of energy could lead to a runaway reaction with potentially serious consequences.

The use of a catalyst renders the system much safer by converting the anhydride more quickly and thereby preventing a large accumulation.

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