Investigation of Error in Measurement of Diesel Consumption for Continuously Running DG Sets

Singhal D.K.

Chandpur Enterprises Ltd., Noorpur Road, Chandpur-246725

ABSTRACT

It was observed during the operation of D G Sets, that the diesel consumption figure varies with time, i.e., the consumption appears to be on the lower side comparable to that after some time of diesel filling. Further more, even good care was being taken in measurement of diesel filed quantities, the diesel stock in the storage tank was found to be short by 3-5% after every tanker load consumption. This paper highlights the causes for the same and possible remedial measures to be taken to prevent error arising due to this wrong measurement.

INTRODUCTION:

Due to ever increasing cost of power, D G Sets are becoming more and more popular these days. For small paper mills of around 20-25 TPD, where power constitutes a significant proportion of total cost of production, the annual cost of diesel may be around a couple of crores in terms of rupees, a figure of the order of the cost of a paper machine itself. Hence, the operation of D G sets becomes very important. Apart from this, specific diesel consumption, D G Set is also a barometer for the health of D G Set. Higher diesel consumption is not only harmful financially, because of high power generation cost but also it results in increased pollution, poor life of pistons and rings, and possibility of premature failure of the set.

The author faced a typical problem in several D G Sets under operation at various plants. In almost all of the cases which were of similar nature, following points were observed.

1. Diesel consumption at a constant load was reduced by around 25% during the hour the diesel was filled in service tank.

2. After consumption of each tanker load of 12 KL, the physical stock was found to be short by 1.5-3%.

Existing setup

To describe the problem in detail, let us have a look at the existing setup in a particular mill.

1. A tanker of suitable capacity is installed for storage of diesel received.
2. Each D G Set is equipped with a tank of capacity suitable for 12-15 hours of operation. This service tank is calibrated and a gauge glass is mounted.
3. The diesel is supplied from the service tank and after passing through water filter, diesel filter, actuator and pump, it is supplied to distributor and finally to the injectors.
4. The diesel supply and pressure is regulated by an EFC (Electronic Fuel Governor Controller) by means of recirculating the excess diesel from actuator and distributor back to the service tank.
5. The recirculated diesel temperature after actuator and distributor is about 80°C. When this diesel goes into the service tank, the diesel temperature in the tank rises to about 50-70°C depending on load and ambient temperature conditions.

Existing method for calculation of diesel consumption:

Diesel consumption = Opening Balance +Diesel Received +Closing Balance

Diesel Received = Final Stock — Initial Stock + Diesel Consumption during filling Time

Physical stock short due to incomplete calculation:

Using the above procedure, it was observed that there existed a 1.5-3% shortage in diesel. That is for a tanker of 12 KL, finally after consumption, the stock is found to be short by 200-350 Lit.

DISCUSSIONS:

This shortage of diesel is due to the following reason:-

During operation, the service tank diesel temperature rises, when the diesel is filled in the fresh diesel cools down the diesel present in the service tank. In this way, the diesel volume decreases, and a part of diesel filled is used to make up the level and thus we get wrong measurement of diesel added to the service tank.

For example if there is 400 lit, in service tank, and we add diesel to make it to 1000 lit, we presume that the diesel received is -

= 1000—400+Diesel consumption during fill time, say 8 lit.

= 608 Lit.

But actually, during filling diesel, folllowing things happen

1. Initial diesel (400 Lit.) cools down rapidly in a short span of diesel filling, and due to increased specific gravity the quantity of the initial diesel fraction reduces in volume to say 380 Lit.

2. Diesel added now has to make up the volume from 380 Lit. to 1000 Lit. (Ofcourse, simultaneously supplying diesel to DG) and thus diesel received is -

=1000- 380+8 Lit.

=628 Lit.

After the filling process is completed, the temperature begins to rise, thereby increasing volume in the service tank, e.g. for a particular set, if diesel consumption is 60 LPH, the diesel temperature rise will increase volume by say 20 lit. and we get a figure of only 40 lit. consumption during this hour. After this time, the temperature reaches to the normal operating temperature and we start getting the same 60 LPH diesel consumption.

Problems due to inacurate Computation of diesel consumption

The inacurate calculation of diesel consumption causes following problems-

1. Physical stock imbalances causing wrong estimation about stock at a particular time.
2. False optimistic information about the DG Performance. Due to the wrong consumption statistics, one occasionally assumes a higher value of power generation per lit. or a lower cost of generated power than the actual value.
3. Due to continuous stock mismatch, there arises a possibilty of misuse and theft of diesel, which cannot be detected easily.

Remedial solutions

The most obvious and simple method to the above problem is to add the short quantity (3-5%) to that calculated as described above.This can be done by multiplying the calculated diesel consumption quantity by 1.03 or 1.04 or 1.05 whatever the case may be. The only difficulty with this is that in some of the small mills the operators are not very good in mathematics and may make some calculation mistake.

There also exists a possibility to install a heat exchanger for the return diesel so that the diesel temperature does not rise. But by this way we loose small quantity of the heat energy available in the form of sensible heat with recirculated diesel. Furthermore additional power is required for the cooling water to pass through heat exchanger.

Another proposed solution is to fabricate a recirculation header in which the recirculated diesel will be supplied. In this system, the recirculation header, the level of which is maintained by incoming diesel from the service tank, receives the all hot recirculated diesel. Here the pipeline between both should be sufficient enough to minimize the heat transfer from the header to service tank.

Design of recirculation header

The recirculation header has to consist of four lines-

(1) Input from the diesel service tank (at bottom),

(2) Outlet to DG set (from bottom),

(3) Inlet for recirculated diesel (at top) and

(4) Vent to atmosphere (extreme top).

These lines are of same size as the diesel inlet line to DG set. The header should be at least 15% extra in height than that of service tank, as it is supposed to contain diesel at elevated temperature, which has low gravity. The header diameter may be kept some 10 to 15 times that of diesel inlet pipeline.

Accident prevention

This study was actually done much earlier, and the implementation was done in a mill just a couple of months back. But, as the author came to know recently, in a sugar mill located in western UP, due to increase of diesel service tank temperature, the service tank blasted. This resulted in splashing of diesel to nearby areas and severe fire accident during Summer 2000. The mill had to be shut immediately and the operations could be resumed after 14 hours. As by the proposed method of installation of recirculation header, the service tank temperature rise can be avoided, no such accident would take place.

CONCLUSION:

After investment of just a few hundred rupees for installation of recirculation header a good level of safety is achieved. Furthermore, the wrong diesel consumption data can be avoided by using the recirculation header. It is also the need of time to investigate into the matter more carefully, and to develop D G service tank of improved design.