Catalyst Handling in a Nitrogen Atmosphere

Skimming operations performed on dry catalyst in a nitrogen atmosphere can be accomplished with a minimum of reactor downtime and catalyst loss.

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This article is a summary of Catalyst Services' experience in handling catalyst under a nitrogen or oxygen limited atmosphere. While this is not a new operation, we believe that by utilizing sound safety and operating practices, the job can be accomplished in a safe and efficient manner.

There are three major areas to consider when handling catalyst in this manner, therefore, the following is divided into three sections.

1. Why handle catalyst under a nitrogen atmosphere?
2. Considerations for working under these conditions
3. Equipment available to the industry

Why Handle Catalyst Under a Nitrogen Atmosphere?

We do not advocate that every catalyst job be performed under a nitrogen atmosphere, however, we do believe that if done correctly, it can become an effective tool to accomplish a job.

There is no one single factor to evaluate when considering catalyst change-out under a nitrogen atmosphere. This is due to the various reactor designs, types of process, types of catalyst, catalyst condition, and perhaps the most important, why the catalyst change-out is necessary.

The most widely used method to handle pyrophoric catalyst has been to flood the reactor with water, thereby allowing reactor entry and catalyst removal without the concern of catalyst oxidation. There are several problems associated with this method: 1) the nature of the work which becomes very messy and dirty, 2) potential corrosion in the reactor, 3) increasing the total weight on the lower grids and screens which could cause possible failure, 4) removal of the bottom bed support should it become contaminated with catalyst dust and fines and 5) the possibility that the wet catalyst dust will hamper the catalyst free fall.

It is also our belief that handling catalyst in the dry state can be done faster, thereby reducing change-out time.

Two other important possibilities are available when handling the catalyst dry and under nitrogen. The first is a single bed removal on multi-bed reactors, or a skimming operation where only a small affected layer of catalyst is removed. The skimming operation can be completed with minimum reactor downtime and with minimum catalyst losses.

Several plants in the petrochemical and refinery industry regenerate their catalyst prior to change-out. This procedure increases the total shutdown time due the expenditure for regeneration facilites.

Working Conditions

Safety is the single most important factor any time personnel are required to enter an atmosphere that will not support life. Safety considerations or evaluations can be divided into four major life. Safety considerations or evaluations can be divided into four major areas:

1. Equipment
2. Personnel
3. Reactor design
4. Safety procedures

Equipment – According to the new OSHA Standards, only approved breathing equipment can be used in hazardous atmospheres. A hazardous atmosphere as defined in the Federal Register Part II published by the Department of Interior on March 25, 1972, "is any atmosphere containing a toxic or disease producing gas, vapor, dust, fumes, mist or pesticide, either immediately or not immediately dangerous to life or health or any oxygen-deficient atmosphere. An oxygen deficient atmosphere is any atmosphere which contains less than 19.5%, by volume, at sea level."

The following types of breathing equipment can be used in a hazardous atmosphere:

1. Self-contained breathing apparatus
2. A combination air line respirator and self-contained unit for escape or self-rescue
3. A supplied-air respirator which consists of a motor or hand-operated blower that permits the free entrance of air when the blower is not operating

Selection or equipment used for work under nitrogen should be one of the above types or others that the Bureau

of Mines approves at a later date.

Our experience has been with the air line respirator which we believe provides the greatest safety.

The selection of equipment should also take into consideration the work task to be performed to insure adequate personnel freedom of movement and that stand-by or emergency systems are available.

The selection of equipment is the first step, the next is to establish a preventive maintenance program to insure the equipment is maintained in excellent condition. The maintenance program should include the following components:

1. Regulators
2. Face shields
3. Masks or helmets
4. Harnesses
5. Escape bottles and valves
6. Pressure hoses
7. All alarms
8. Safety lines
9. Lifting devices
10. Instruments

In conjunction with the main equipment, we would recommend that consideration be given to the following auxiliary or support equipment:

Gas analyzers should be used to monitor oxygen content inside the reactor at all times when personnel are in the converter. We have found that a continuous oxygen analyzer is the best monitoring device. A portable unit should be available as a stand-by and to check the accuracy of the continuous unit.

Workmen have safety harness and safety line for getting out of the vessel; communications are maintained with crew outside.

Dual analyzers used for measuring oxygen and combustibles can be used if the condition warrants. Combustible analyzers should be capable of operating under a nitrogen atmosphere.

Communications is one of the most important items for this type of work. It is recommended that all persons, both supervision and workmen, involved in this operation be in voice contact with each other. Voice contact increases confidence in the total operations plus it provides job supervision with instantaneous contact should problems arise. Good communications with a routine voice check of persons under helmet can detect panic or concern and corrective action can be taken.

We require that the safety supervisor manning the control console advise the people under helmet how the system is performing at regular intervals. This is done to build confidence and to assure the persons exposed to the hazardous conditions that all systems are operating correctly.

Any time personnel are required to work in reactors with internal manways and tray sections, and work is performed below the internal section, we recommend that a lifting device be employed for emergency conditions. We have found that a twin davit system equipped with air winches fulfills the job requirements. This device can also be used to transport people in and out of the vessel, however, we have found that our personnel had rather climb in and out.

Personnel – The operation of all equipment requires trained and qualified personnel. This has never been truer than in the operation of equipment that supports life. Both the job supervisors and workmen should be trained in the equipment operation and in the job task to be performed. It is essential that the workmen be in good physical health and that a complete physical examination be given prior to their acceptance for this type of work. Besides good physical condition, the following should be considered in selecting personnel:

1. Safety attitude
2. Emotional stability
3. Size
4. Age
5. Willingness to work in these conditions

Supervision should also be trained in the following areas:

1. Equipment operations
2. Equipment maintenance
3. First aid
4. Safety procedures
5. Emergency procedures
6. Physiological training

Staffing required – On most jobs we have found that a safety team consisting of five men per shift provides the best staffing. The team consists of two supervisors and three workmen.

The equipment that we are using requires that a supervisor be stationed at the control console and another supervisor at the vessel entry point to supervise and assist the suiting up of personnel and coordinate the overall