Practical Experience in the Main Fertilizers Containing Nitrogen

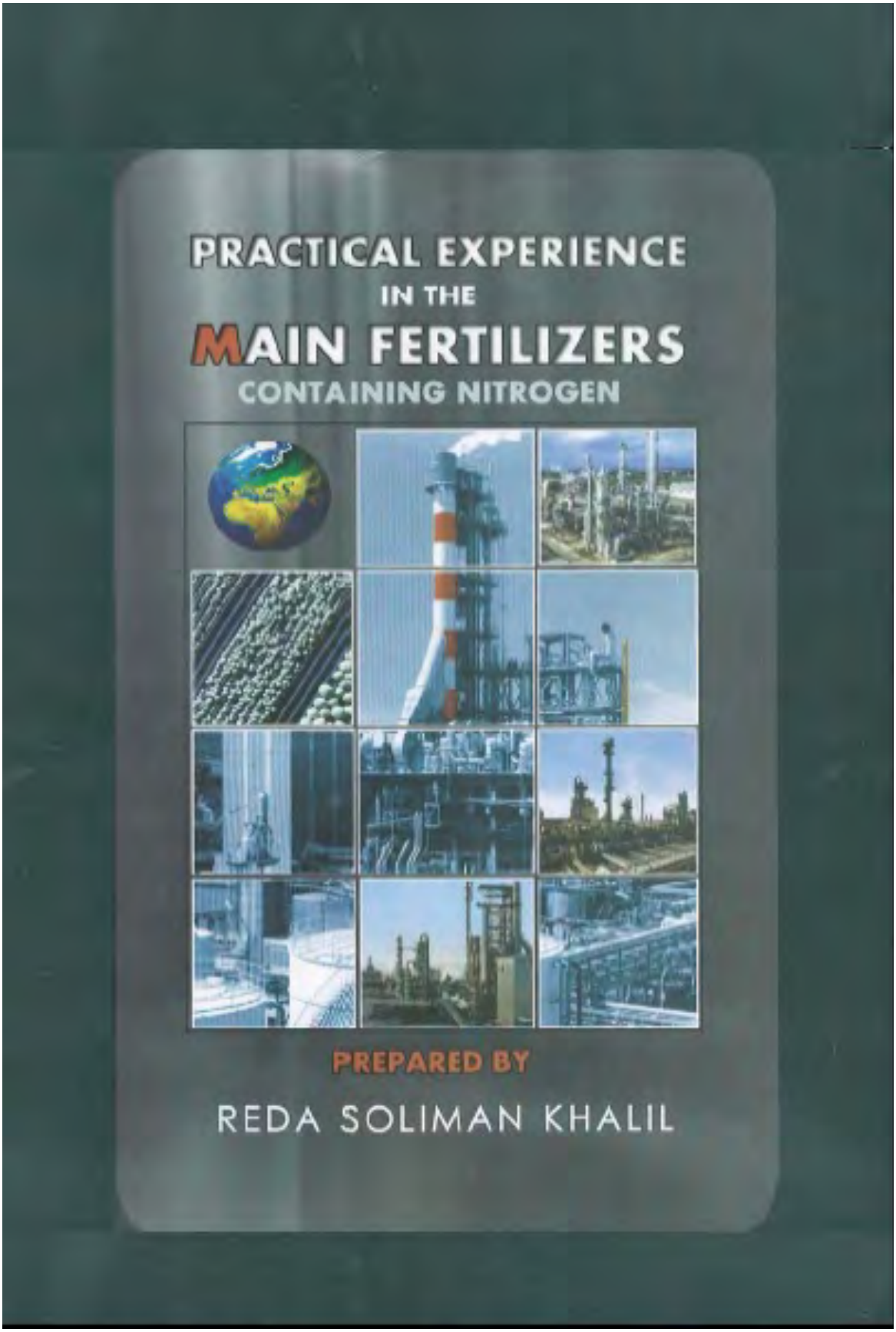
Explosion Hazards in Urea Plants

Engineer Reda Soliman Khalil
Board Member and Vice President of Production Affairs
Abu Qir Fertilizers & Chemical Industries Company
Alexandria, Egypt

Content

1. Introduction

In March 2004, Engineer Reda Soliman Khalil has published the first edition of a very interesting and elaborative book describing the Practical Experience in the Main Fertilizers Containing Nitrogen.
In this book, which is unique in the industry, Engineer Khalil's focuses on three main fertilizer types: Urea, Ammonium Nitrate and Ammonium Phosphate, in addition to Nitric Acid, which is highly involved in the manufacturing of other various nitrogen-based types of fertilizers.
This book aims at combining the theoretical and practical experience in the main popular fertilizers produced mainly from ammonia, which is the basic access to all the nitrogenous fertilizers that involve nitrogen as a manufacturing component.
Currently Engineer Khalil is Managing Director, Fertilizers, ORASCOM CONSTRUCTION INDUSTRIES and Board Member, SORFERT ALGERIA.
This part discusses Explosion Hazards in Urea Plants and more specific how to minimize the explosion risks and effects in a urea plant.


PRACTICAL EXPERIENCE
IN THE
MAIN FERTILIZERS
CONTAINING NITROGEN
PREPARED BY
REDA SOLIMAN KHALIL

D.3) How does the modern process minimize or eliminate the explosion possibilities?

In the recent time, the processes are modified to minimize the possibilities of ignition or explosion due to the presence of explosion mixtures by the implementation of the hydrogen-removal unit.

As mentioned before, the hydrogen removal unit is a selective catalytic process using a catalyst made from 0.3% weight platinum with aluminium. The hydrogen is removed from carbon dioxide by the catalytic oxidation to water.

D.4) Explosion and Flammability Risk in Urea Plant

The flammability limits of the mixtures containing ammonia, hydrogen, and methane at the elevated temperature are well known with respect to the combustion that exists between ammonia and air mixtures on one hand, and hydrogen in mixtures on the other hand.

For an explosion to occur, there must be a gas mixture with a composition within the flammability limits and there must be a source of ignition.

In the urea plants, the combustible components of concern are ammonia and hydrogen. In some cases, the amount of methane is taken as another source of explosion or ignition. The source of methane is the liquid ammonia.

It should be noticed that there is a big difference in the mixture reactivity if we compare the hydrogen / air mixture to ammonia / air mixtures, in other words, the minimum ignition energy for hydrogen / air mixtures is much lower when compared to ammonia / air mixtures, or there is a large difference in reactivity between these two combustible mixtures.

In the Urea plant, there are two different manners of an explosion:
- First there are the direct effects, such as the rupture and the fragmentation of equipment, and the release of hot process fluid. These direct effects form a threat to people in the direct vicinity of the equipment concerned.
- Second the rupture of equipment that results in a loss of the containment of chemicals present in the equipment, which causes a much larger risk.

In the urea plant, in some equipment items, large amounts of ammonia at elevated temperature and pressure are present.
Ammonia is a toxic substance, where it is corrosive to eyes, skin, and respiratory tract.

Inhalation of vapour and fumes can cause severe breathing difficulties (lung oedema), which can increase the risk of death in some serious cases.
The release of large amounts of ammonia can affect at considerable distances from the urea plants. These effects justify a differentiation in the safety approach, depending on the amount of ammonia that would be released in case of loss of containment.

D.5) Minimizing the effects of Explosion in the Urea Plant

Stamicarbon modified the design of the HP scrubber to (doma area) constructions. These are provisions that limit the amount of damage in case of an explosion to the internals of the relevant equipment items. This kind of construction has been applied in several forms in the high-pressure urea scrubber.

In the case of explosion in the protected part of equipment, the internals will be damaged and the plant will be shutdown for repair, without any release of ammonia to environment.