

TECHNOLOGY & COSTS**Technoeconomics - Energy & Chemicals (TECH)****TECH 2021S9 Ammonium Nitrates**

Table of Contents

A Report by **NexantECA, the Energy and Chemical Advisory company**

Published Date: December 2021

www.nexanteca.com/subscriptions-and-reports**Contents**

1	Executive Summary	1
2	Business Overview	4
2.1	Introduction.....	4
2.2	Historical Development	8
2.3	Value Chain.....	11
2.3.1	Calcium Ammonium Nitrate	12
2.3.2	Urea Ammonium Nitrate (UAN).....	12
2.3.3	Nitro Phosphates, NPKs, and Others.....	13
2.4	Product Crystalline States	14
2.5	Handling and Storage.....	15
2.6	Properties and Hazards.....	16
2.7	Safety and Environmental Developments	17
2.7.1	AN Safety History	17
2.7.2	Potential as Zero-Carbon Fertilizer via Green Ammonia	19
2.8	Technology Licensing Status	20
2.9	SWOT Analysis	21
3	Process Technology	22
3.1	Introduction.....	22
3.2	Casale	23
3.2.1	Background	23
3.2.2	Process Description	23
3.3	KBR-Weatherly.....	29
3.3.1	Background	29
3.3.2	Process Description	29
3.4	Espindesa.....	30
3.4.1	Background	30
3.4.2	Process Description	31
3.5	ThyssenKrupp	37
3.5.1	Background	37
3.5.2	Process Description	37
3.6	INCRO	46

3.6.1	Background	46
3.6.2	Process Description	47
4	Process Economics	53
4.1	Costing Basis	53
4.1.1	Investment Basis	53
4.1.2	Pricing Basis.....	53
4.1.3	Cost of Production Basis	54
4.2	Production Cost Estimates	55
4.2.1	Cost of Producing Ammonium Nitrate via a Vacuum Neutralization Process	56
4.2.2	Cost of Producing Ammonium Nitrate via a Pressure Process.....	61
4.2.3	Cost of Producing Urea Ammonium Nitrate and Calcium Ammonia Nitrate	66
4.3	Sensitivity to Feed Pricing	72
5	Market Analysis	74
5.1	Global Overview	74
5.1.1	Key Developments	74
5.1.2	Demand.....	74
5.1.3	Supply	76
5.1.4	Supply, Demand, and Trade	77
5.2	North America	80
5.2.1	Consumption	80
5.2.2	Supply	80
5.2.3	Supply, Demand, and Trade	81
5.3	Western Europe	82
5.3.1	Consumption	82
5.3.2	Supply	82
5.3.3	Supply, Demand, and Trade	82
5.4	Central and Eastern Europe (excludes Russia)	84
5.4.1	Consumption	84
5.4.2	Supply	84
5.4.3	Supply, Demand, and Trade	84
5.5	China	86
5.5.1	Consumption	86
5.5.2	Supply	86
5.5.3	Supply, Demand and Trade	86

Appendices

A	Definitions of Capital Cost Terms Used in Process Economics.....	89
B	Definitions of Operating Cost Terms Used in Process Economics	94
C	TECH Program Title Index (2011-2021)	97

Figures

Figure 1	Overview of Ammonium Nitrate Process and Products	1
Figure 2	Global Ammonium Nitrate Supply, Demand, and Trade	2
Figure 3	Summary of Ammonium Nitrate via a Vacuum Neutralization Process Production Costs.....	3
Figure 4	Global Share of Nitrogenous Fertilizers by Product	4
Figure 5	FGAN for Direct Application versus AN of Other Application Production.....	7
Figure 6	Ammonium Nitrate Molecular Structure.....	8
Figure 7	Timeline of Nitrogen Fixation Process Development	9
Figure 8	Global Population and NH ₃ Production	10
Figure 9	Overview of an Integrated Ammonium Nitrates Complex	11
Figure 10	Global CAN Production and Consumption by Region in 2019	12
Figure 11	Global UAN Capacity by Region	13
Figure 12	Accidental Ammonium Nitrate Incident Timeline.....	17
Figure 13	Ammonium Nitrate – New Entrant SWOT Analysis.....	21
Figure 14	Block Diagram of the GPN Pipe Reactor Process	24
Figure 15	Philosophy of pH Monitoring in the Pipe Reactor.....	25
Figure 16	Typical Prilling Flow Diagram for Use Downstream of a Pipe Reactor (<i>Source: Fertilizer Manual</i>).....	28
Figure 17	Overview of KBR Weatherly's Ammonium Nitrate Process	29
Figure 18	ESPINDESA AN Solution Process Flow Diagram.....	32
Figure 19	ESPINDESA Prill LDAN/HDAN Flow Diagram	34
Figure 20	ESPINDESA CAN Granulation Process Flow Diagram	36
Figure 21	TKIS's Vacuum Neutralization Process.....	38
Figure 22	Typical Pressure Neutralization with Direct Heat Utilization (TKIS).....	40
Figure 23	Typical Pressure Neutralization with Additional Steam Generation (TKIS).....	41
Figure 24	Uhde's Stand-Alone UAN Process	44
Figure 25	Uhde's Stand-Alone Urea Offgas UAN Process	45
Figure 26	Summary of Ammonium Nitrate via a Vacuum Neutralization Process Production Costs.....	60
Figure 27	Summary of Ammonium Nitrate via a Pressure Neutralization Process Production Costs.....	65
Figure 28	Summary of Urea/Calcium Ammonium Nitrate via Conventional Processes Production Costs	72
Figure 29	Regional Ammonia Market Prices	72
Figure 30	Sensitivity of Ammonium Nitrates Costs of Production to Feed Price.....	73
Figure 31	Global Ammonium Nitrate Supply, Demand, and Trade	78
Figure 32	Global Ammonium Nitrate Net Trade	79
Figure 33	Ammonium Nitrate Supply, Demand, and Trade – Western Europe	83
Figure 34	Ammonium Nitrate Supply, Demand, and Trade – Central and Eastern Europe (excludes Russia)	85
Figure 35	Ammonium Nitrate Supply, Demand and Trade – China	87

Tables

Table 1	Nitrogen Contents of Various Nitrogenous Fertilizers	6
Table 2	Ammonium Nitrate Properties	16
Table 3	Patents Concerning Safety Improvements for AN Products	18
Table 4	Technology Licensors	20
Table 5	Prices of Raw Materials, Products, Utilities and Labor	54
Table 6	Cost of Production Estimate for: Ammonium Nitrate Process: Conventional Vacuum Neutralization; USGC Basis	57
Table 7	Cost of Production Estimate for: Ammonium Nitrate Process: Conventional Vacuum Neutralization; Western Europe Basis	58
Table 8	Cost of Production Estimate for: Ammonium Nitrate Process: Conventional Vacuum Neutralization; China Basis	59
Table 9	Summary of Ammonium Nitrate via a Vacuum Neutralization Process Production Costs.....	60
Table 10	Cost of Production Estimate for: Ammonium Nitrate Process: Conventional Neutralization at 4 bar; USGC Basis	62
Table 11	Cost of Production Estimate for: Ammonium Nitrate Process: Conventional Neutralization at 4 bar; Western Europe Basis	63
Table 12	Cost of Production Estimate for: Ammonium Nitrate Process: Conventional Neutralization at 4 bar; China Basis	64
Table 13	Summary of Ammonium Nitrate via a Pressure Neutralization Process Production Costs.....	65
Table 14	Cost of Production Estimate for Urea Ammonium Nitrate Process: Conventional UAN Production; USGC Basis	67
Table 15	Cost of Production Estimate for Urea Ammonium Nitrate Process: Conventional UAN Production; Western Europe Basis.....	68
Table 16	Cost of Production Estimate for Calcium Ammonium Nitrate Process: Conventional CAN Production; Western Europe Basis.....	69
Table 17	Cost of Production Estimate for Urea Ammonium Nitrate Process: Conventional UAN Production; China Basis	70
Table 18	Summary of Urea/Calcium Ammonium Nitrate via Conventional Processes Production Costs	71
Table 19	Global Ammonium Nitrate Supply, Demand, and Trade	78
Table 20	Ammonium Nitrate Supply, Demand and Trade North America	81
Table 21	Ammonium Nitrate Supply, Demand and Trade – Central & Eastern Europe (excludes Russia)	85
Table 22	Ammonium Nitrate Supply, Demand and Trade - China	87



TECHNOLOGY & COSTS

Technoeconomics - Energy & Chemicals (TECH)

The NexantECA Subscriptions' Technoeconomics - Energy & Chemicals (TECH) program is recognized globally as the industry standard source for information relevant to the chemical process and refining industries. Technoeconomics - Energy & Chemicals (TECH) reports are available as a subscription program or on a single report basis.

Contact Details:

Americas:

Marcos Nogueira Cesar, Vice President, Global Subscriptions and Reports
Phone: + 1-914-609-0324, e-mail: mcesar@NexantECA.com

Erica Hill, Client Services Coordinator, Subscriptions and Reports
Phone: + 1-914-609-0386, e-mail: ehill@NexantECA.com

EMEA:

Anna Ibbotson, Vice President, Sales and Marketing
Phone: +44-207-950-1528, aibbotson@NexantECA.com

Asia:

Chommanad Thammanayakatip, Managing Consultant
Phone: +66-2793-4606, email: chommanadt@NexantECA.com

NexantECA Subscriptions and Reports provide clients with comprehensive analytics, forecasts and insights for the chemicals, polymers, energy and cleantech industries. Using a combination of business and technical expertise, with deep and broad understanding of markets, technologies and economics, NexantECA provides solutions that our clients have relied upon for over 50 years.

Copyright © 2000-2021 NexantECA (BVI) Limited. All rights reserved