JNC(CHISSO) PVC PROCESS TECHNOLOGY

Introduction

JNC Corporation, formerly known as "Chisso Corporation", ("JNC") started its commercial production of polyvinyl chloride ("PVC") in Minamata, Japan in 1941 and it is the first PVC producer in Japan. In 1950's, JNC expanded Minamata plant and also constructed Takefu plant which was a joint venture company with Shinetsu. Furthermore, JNC built its second PVC plant in Goi in 1964 and its third PVC plant in Mizushima in 1970. While JNC was producing PVC products in its own plants, JNC started licensing PVC process technology and vinyl chloride monomer ("VCM") removal process technology from the end of 1970's. JNC has licensed the suspension PVC process technology to 26 companies and total annual capacity of licensed plants has reached 8.2 million metric tons. In the meantime, we are also licensing a unique VCM removal process from aqueous PVC slurry to world-wide companies more than 131 units. JNC PVC process technology can produce various grades of PVC products with K-values ranging from 51 to 97 for homopolymers and copolymers with vinylacetate as well as special grades of PVC products having excellent properties. JNC was a pioneer in Japanese PVC industry and has over 60 years' experience in the fields of PVC production, compound and processing.

Advantages of JNC PVC Process

- **High Quality PVC Products**

  Requirement level of PVC quality by PVC customers (PVC processors) in Japan has been the highest in the world. To meet such strictest requirements, JNC, as the first PVC producer in Japan, had been making the best efforts to repeatedly improve the PVC quality for a long time. As a result, JNC PVC quality, such as better transparency, high heat stability, excellent weatherability, superior electrical properties, surpassing processability and excellent gelation, is on the highest level in the world.

- **High Safety and Environmental friendly**

  JNC PVC process plant is designed and operated with high safety and without any pollution, based on our long and rich experience. A basically closed system is used throughout the entire process plant. JNC PVC process can be easily operated without any trouble by adopting concepts of "Simple", "Maintenance Free" and "Safety and environmental friendly" based on more than 60 years' experience of PVC plant operation.

- **Many Licensable PVC Grades**

  Using JNC PVC process, PVC producers can manufacture many types of PVC grades, including commodity types and special types, such as high K-value, low K-value, matted and copolymer, etc. All of these PVC grades have excellent quality, and can be licensed upon customers' requests.

- **Low Production Cost**

  By exhaustive recovery of VCM and energy savings, JNC PVC process

minimizes the consumption of raw materials and utilities. With the adoption of a highly automated DCS control system, JNC PVC process can be operated by small group of employees. This results in low PVC production costs.

- **Low Investment Cost**

  JNC PVC process has been continuously improved so that the higher productivity can be accomplished in tandem with compact facilities and antifouling technology. PVC plant is comprised of unique equipment skillfully and carefully engineered by JNC Engineering Co., Ltd., utilizing its expertise of the chemical project engineering which has been accumulated over 40 years. Therefore, JNC process PVC plant can be constructed at a relatively low investment outlay.

- **Much License Experience and Good After-Services**

  JNC has many licensees of PVC process and VCM removal process in the world. JNC continues to render technical assistance services to our licensees even after start-up of the plant. What we want to demonstrate is that “No licensee has ever complained about JNC PVC process.” In addition, some licensees have obtained JNC PVC process license repeatedly.

JNC PVC Process Description

- **Polymerization Section**

Purified VCM, pure water and other chemicals, including an initiator are charged into a reactor. The reactor contents are vigorously stirred inside the reactor while keeping good suspension conditions. At elevated temperatures, VCM reacts to form the PVC particles in the presence of the initiator. Finally, PVC particles yields by the reaction form dense slurry in the reactor. When the reaction reaches its final stage, the un-reacted VCM is recovered into a VCM gas holder, and the polymer slurry is transported from the reactor to a slurry tank.

- **VCM Recovery Section**

The un-reacted VCM gas in the gas holder is compressed and condensed in the recovery section. The recovered liquid VCM is stored in a vessel and is reused as the feedstock for the succeeding polymerizing reaction.

- **VCM Removal Section**

The PVC slurry in the slurry tank is fed to stripping column, where the un-reacted VCM is effectively stripped out from the slurry with steam and stripped slurry is transferred to the drying section. The final VCM content in PVC is less than one (1) ppm. The VCM

Removal system uses heat exchanger to minimize the steam consumption. The hot water is used as washing for each stage inside the stripping column. This contributes to continuous operation for a long term without stopping the feed. By a unique design of this column, it can achieve high efficiency, low steam consumption without any quality problem.

- **Drying Section**

  The PVC slurry from the VCM Removal section is fed into the centrifuge continuously in order to separate wet PVC cakes from water. The wet PVC cakes discharged from the centrifuge are dropped into a fluidized bed dryer, where moisture is removed from the PVC powder. The dried PVC powder passes through product sieves to eliminate any oversized particles, and is conveyed pneumatically to the product silos. The PVC product thus obtained maintains uniform quality.

JNC PVC Grades

JNC has following grades which can be licensed upon customers' requests:

Type	K-Value	BD	Application
Commodity	56 ~ 74	0.57 ~ 0.48	Rigid/Flexible
Low Molecular	51	0.51	Rigid
High Molecular	80 ~ 97	0.42 ~ 0.40	Flexible
Matted	57 ~ 72	0.47 ~ 0.40	Rigid/Flexible
Copolymer	60 ~ 75	0.57 ~ 0.50	Rigid/Flexible
High Impact	67	0.55	Rigid

JNC Licensed Plants

- **PVC Process**

  -- 42 licenses

  -- Licensed Companies: 26

  -- Licensed Countries: Taiwan, Indonesia, China, Thailand, India, Iran, Japan and Pakistan

  -- Total Capacity of JNC Licensed Plants: 8.2 million t/y

- **VCM Removal Process**

  -- A lot of licenses

  -- Licensed units: 131 in total

  -- Licensed Countries: Japan, Taiwan, Korea, Germany, Indonesia, France, Belgium, Argentina, Spain, Greece, USA, Thailand, China, India, Iran and Pakistan

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