

Injection Moulding 4.0

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October 21, 2023

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# Preface

# This report has been written in October 2023 in

# Introduction

# Answer to Question no. 1

# Solution

# Structure of ABS SINKRAL F332

# ABS SINKRAL F332 is a thermoplastic polymer composed of three main monomers:

# 

# Acrylonitrile (A): Provides rigidity and resistance to chemicals.

# Butadiene (B): Imparts resilience and impact resistance.

# Styrene (S): Contributes to ease of processing and surface hardness.

# The polymerization of these monomers results in an amorphous structure, which means the molecular chains are not arranged in a regular, crystalline pattern. This amorphous nature gives ABS SINKRAL F332 its exceptional properties, including impact resistance, toughness, and good processability.

# Application of ABS SINKRAL F332

# ABS SINKRAL F332 is a versatile material used in various industries for a wide range of applications:

# Automotive: Commonly used for interior components such as dashboards, instrument panels, door handles, and trim parts due to its excellent impact resistance and durability.

# Consumer Goods: ABS SIKRAL F332 is found in everyday consumer products like toys, luggage, and small appliances. Its impact resistance makes it suitable for these applications.

# Electronics: It is used in the electronics industry for casings, connectors, and housing of devices due to its electrical insulating properties and ease of molding.

# Construction: ABS SINKRAL F332 is employed in construction materials like pipes and fittings as it offers a good balance of strength, toughness, and chemical resistance.

# The material’s versatility, coupled with its unique combination of properties, makes ABS SINKRAL F332 a popular choice for various product categories in different industries.

# Structure of SAN KOSTIL B266

# SAN KOSTIL B266 is a thermoplastic polymer that belongs to the class of styrene-acrylonitrile (SAN) copolymers. This material is created by combining two main monomers:

# Styrene (S): Styrene contributes to the material’s transparency, surface hardness, and processability.

# Acrylonitrile (AN): Acrylonitrile enhances the material’s chemical resistance and strength.

# The resulting structure of SAN KOSTIL B266 is highly transparent and amorphous, which means its molecular chains lack a regular, crystalline pattern. This amorphous structure gives the material its exceptional optical clarity.

# Application of SAN KOSTIL B266

# SAN KOSTIL B266 is commonly used in applications where transparency and optical clarity are of paramount importance:

# Food Packaging: SAN KOSTIL B266 is employed in the production of transparent food container, bottles, and packaging material. Its optical clarity allows consumers to view the contents.

# Medical Devices: In the medical industry, SAN KOSTIL B266 is used for the manufacturing of transparent medical devices, including syringes, vials, and diagnostic equipment, where the visibility of contents is crucial.

# Consumer Electronics: It is used in the production of cases, covers and screens for electronic devices such as mobile phones, tablets, and laptops. Its transparency complements the aesthetic appeal of these products.

# Optical Components: SAN KOSTIL B266 can be found in optical lenses, light guides, and other optical components where clarity and light transmission are essential.

# SAN KOSTIL B266 is prized for its high transparency, optical properties, and chemical resistance, making it an ideal choice for applications where aesthetics and visual appeal are as important as material performance.

# Viscosity Analysis

# Viscosity is a crucial property in injection molding, affecting flow behavior and filling of the mold. A lower viscosity indicates easier flow, while a higher viscosity implies more resistance to flow. To determine which material has the highest viscosity, we will compare their viscosity based on the Figure 1 and Figure 2 below:

# ABS SINKRAL F332 Viscosity Plot: Figure 1 for ABS SINKRAL F332 shows that its viscosity decreases with increasing temperature, and that is typical for thermoplastic materials. The graph displays a linear decrease with temperature, and this behavior tells us that ABS SINKRAL F332 has higher viscosity at lower temperatures, and that it gradually becomes less viscous as temperature rises.

# SAN KOSTIL B266 Viscosity Plot: Similarly, the figure 2 for SAN KOSTIL B266 also shows the decrease in viscosity as the temperature arises, with a linear trend.

# 

Figure 2 : SAN KOSTIL B 266 Viscosity

Figure 1: ABS SINKRAL F332 Viscosity

# Viscosity Differences

Figure 3: Comparing the materials.

# The observation made by comparing the two materials with each other results in that ABS SINKRAL F332 has a higher viscosity than SAN KOSTIL B266. The figure 3 to the right shows the comparing between the two materials where the orange line is ABS SINKRAL F332, and the blue is the material SAN KOSTIL B266.

# Volumetric Shrinkage Analysis (pvT Analysis)

# Volumetric shrinkage pertains to the change in a material’s volume as it cools after injection into a mold. Comparing the pvT charts of ABS SINKRAL F332 and SAN KOSTIL B266 offers insights into their volumetric shrinkage behaviors.

# ABS SINKRAL F332 pvT: The pvT chart for ABS SINKRAL F332 characterizes its response to variations in pressure and temperature. Notably, the chart shows an increase in volume (expansion) as temperature rises and a decrease in volume (shrinkage) as pressure escalates.

# SAN KOSTIL B266 pvT: Similarly, the pvT chart for SAN KOSTIL B 266 shows how the material reacts to changes in pressure and temperature. The chart of SAN KOSTIL B266 shows less volumetric expansion with rising temperature.

# Observing the figure 4 below, the ABS SINKRAL F332 has a higher shrinkage compared to SAN KOSTIL B266.

Figure 4: Compared PVT plots of the materials

# Discussion

# Viscosity Analysis

# The comparative analysis of ABS SINKRAL F332 and SAN KOSTIL B266's viscosity reveals distinctive behaviors that directly impact their suitability for injection molding processes. The viscosity-temperature trends depicted in Figures 1 and 2 unveil crucial insights into the flow characteristics of these materials.

# ABS SINKRAL F332, composed of acrylonitrile, butadiene, and styrene, exhibits a characteristic where its viscosity decreases consistently as temperature rises. This trend aligns with typical thermoplastic behavior, displaying a linear decrease in viscosity with temperature. Notably, at lower temperatures, ABS SINKRAL F332 demonstrates higher viscosity, gradually decreasing as temperature increases. This behavior indicates its varying flow properties in response to temperature fluctuations during the molding process.

# In contrast, SAN KOSTIL B266, a styrene-acrylonitrile copolymer, showcases a similar linear decrease in viscosity with rising temperatures, portraying a consistent trend akin to ABS SINKRAL F332. However, the comparative analysis reveals that SAN KOSTIL B266 consistently maintains lower viscosity levels across the entire temperature range in comparison to ABS SINKRAL F332.

# The orange line, representative of ABS SINKRAL F332, consistently maintains higher viscosity levels compared to the blue line, denoting SAN KOSTIL B266. This difference signifies that ABS SINKRAL F332 generally presents more resistance to flow at all temperatures, posing potential implications for mold filling, flow behavior, and overall processing conditions.

# Volumetric Shrinkage Analysis (pvT Analysis):

# Furthermore, the pvT charts provide significant insights into the volumetric behaviors of these materials during the cooling phase after injection molding. ABS SINKRAL F332 exhibits a more noticeable expansion in volume as temperature rises, along with a substantial decrease in volume as pressure increases. In comparison, SAN KOSTIL B266 demonstrates less aggressive volumetric expansion with temperature changes, indicating a more stable response to varying temperature conditions.

# When observing the orange line representing ABS SINKRAL F332 and the blue line for SAN KOSTIL B266, it's evident that ABS SINKRAL F332 experiences a more pronounced change in volume with temperature fluctuations. This behavior suggests that ABS SINKRAL F332 might undergo more significant dimensional variations during the cooling phase after molding in comparison to SAN KOSTIL B266, potentially impacting final part dimensions and tolerances.

# Overall Comparison

# The viscosity and pvT analyses collectively indicate that ABS SINKRAL F332 tends to possess higher viscosity levels and more pronounced volumetric changes compared to SAN KOSTIL B266. These distinct characteristics influence flow behavior, mold filling, and dimensional stability, which are critical factors to consider in the selection of materials for injection molding processes. Understanding these differences aids in selecting the most suitable material for specific molding applications based on the desired properties and processing requirements.

# Conclusion

# The comprehensive analysis of ABS SINKRAL F332 and SAN KOSTIL B266, considering their structural composition, applications, and the detailed examination of viscosity and volumetric shrinkage, provides essential insights into the distinct behaviors of these thermoplastic materials in the context of injection molding.

# Material Composition and Applications

# ABS SINKRAL F332, characterized by its composition of acrylonitrile, butadiene, and styrene, demonstrates remarkable impact resistance, toughness, and ease of processing. This versatility has positioned it as a favored material across diverse industries, including automotive, consumer goods, electronics, and construction. In contrast, SAN KOSTIL B266, a styrene-acrylonitrile copolymer, is primarily recognized for its high transparency and finds applications in food packaging, medical devices, consumer electronics, and optical components where optical clarity is paramount.

# Viscosity Analysis

# The examination of viscosity-temperature trends distinctly differentiates the two materials' flow behaviors. ABS SINKRAL F332 consistently displays higher viscosity levels at varying temperatures compared to SAN KOSTIL B266. This higher viscosity of ABS SINKRAL F332 implies more resistance to flow, which may impact the mold filling process during injection molding.

# Volumetric Shrinkage Analysis

# The pvT charts indicate contrasting volumetric behaviors of the materials during the cooling phase. ABS SINKRAL F332 exhibits more significant volumetric changes with temperature fluctuations compared to SAN KOSTIL B266, suggesting potential dimensional variations and challenges in maintaining part tolerances.

# Overall Assessment

# In conclusion, ABS SINKRAL F332 and SAN KOSTIL B266 showcase distinct behaviors that must be carefully considered in the selection of materials for injection molding processes. The higher viscosity and more pronounced volumetric changes of ABS SINKRAL F332 indicate its potential for challenges in flow control and maintaining dimensional stability, especially in comparison to SAN KOSTIL B266, which demonstrates lower viscosity and more stable volumetric behaviors.

# Understanding the material-specific behaviors, viscosity trends, and volumetric responses is pivotal in making informed decisions for selecting the most suitable material for specific molding applications. This knowledge empowers manufacturers to optimize production processes and ensure the quality and integrity of the final molded products.

# Answer to Question Nr. 2

# A screenshot of a computer Description automatically generatedSolution

# For determining the suitable highs and lows for both melt and mold temperatures on the materials ABS SINKRAL F332 and SAN KOSTIL B266, when the values for injection speed, packing pressure and packing time is given was based on the recommendation from the table content at Moldex3D. Figure 5 shown to the right reflects the recommended min and max temperatures for both melt and mold temperatures. Below there is two tables based on the values given (black color) and the values set (red color) for the two materials.

Figure 5 - Content Table of the Materials

|  |  |
| --- | --- |
| ABS SINKRAL F332 | |
| *Low melt temperature =* |  |
| *High melt temperature =* |  |
| *Low mold temperature =* |  |
| *High mold temperature =* |  |
| *Low injection speed =* |  |
| *High injection speed =* |  |
| *Low packing pressure =* |  |
| *High packing pressure =* |  |
| *Low packing time =* |  |
| *High packing time =* |  |

|  |  |
| --- | --- |
| SAN KOSTIL B266 | |
| *Low melt temperature =* |  |
| *High melt temperature =* |  |
| *Low mold temperature =* |  |
| *High mold temperature =* |  |
| *Low injection speed =* |  |
| *High injection speed =* |  |
| *Low packing pressure =* |  |
| *High packing pressure =* |  |
| *Low packing time =* |  |
| *High packing time =* |  |

# Discussion

# The selection of appropriate temperature ranges for both ABS SINKRAL F332 and SAN KOSTIL B266 relied on the recommendations provided by Moldex3D. These values were chosen to align with the suggested minimum and maximum temperatures, ensuring proper flow, solidification, and material integrity during the injection molding process.

# Conclusion

# By adhering to Moldex3D’s provided minimum and maximum temperatures for both melt and mold stages, the chosen values aim to support the ideal processing conditions for ABS SINKRAL F332 and SAN KOSTIL B266. These selected temperatures ranges are intended to optimize the material’s flow, cooling rates, and the overall quality of the final molded products.

# Answer to Question no. 3

# Solution

# Discussion

# Conclusion

# Answer to Question no. 4

# Solution

# Discussion

# Conclusion

# Answer to Question no. 5

# Solution

# Discussion

# Conclusion

# Summary

# List of References

# Appendix 1