TECHNICAL DATA SHEET

- APPLICATION -

Neusilin®

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Application in Solid Dispertions

Neusilin® is an excellent adsorbent carrier for solid dispersion. Solid dispersions can be prepared via hot melt granulation and Hot Melt Extrusion (HME) to improve dissolution profile of poorly water soluble drug. For drug with high melting points, HME can be prepared by simple mixing of crystalline drug and Neusilin® before passing it through the extruder. The extruded sample can be recovered as amorphous power and then converted to tablets through direct compression. Neusilin® has ability to maintain amorphous state of APIs is well recorded. Several publications and commercial success validate that Neusilin® keeps the drug amorphous and stable under accelerated stability as well as long term storage conditions[1-2].

Advantage of Neusilin® for solubility enhancement compared to conventional polymer in HME based solid dispersion

- High drug loading of water insoluble drugs
- Amorphous with protection from humidity, compaction properties and thermal stability
- High surface area and porosity
- High throughput – extrusion die is not used
- Downstream processing is minimized
- Excellent flow and compaction properties of the extruded formulations (e.g. tablets, capsules)
- Excellent stability compared to conventional polymer because Neusilin® helps to minimize conversion of amorphous API to crystalline API due to it's moisture adsorption capacity.
- Suitable for high melting drug because Neusilin® has very high thermal stability
- Faster release of drug in all the dissolution medium pH compared to pH dependent conventional polymers

Neusiln® US2 for Hot Melt Extrusion (HME) of Indomethacin-Neusilin® amorphous drug complex[1]

Research study[1] was carried out to evaluate the performance of Neusilin® as a novel inorganic carrier in Hot Melt Extrusion (HME) processing of indomethacin (IND) for the development of solid dispersions. A continuous extrusion process at various IND/excipient blend ratios (20%, 30% and 40%) was performed using a twin-screw extruder. SEM, DSC and XRPD based physicochemical characterization demonstrated that, IND remains in amorphous nature within the porous network of the inorganic material for all extruded formulations. Further, AFM and FTIR studies also revealed a single-phase amorphous system and intermolecular H-bonding formation. The IND/MAS extrudes showed enhanced IND dissolution rates as 100% drug released within 1 h. Stability studies under accelerated conditions (40 °C, RH 75%) showed that MAS retained the physical stability of the amorphous solid dispersions even for 12 months. Refer below image to understand HME process using Neusilin® US2.

Figure 1: HME process Indomethacin-Neusilin®

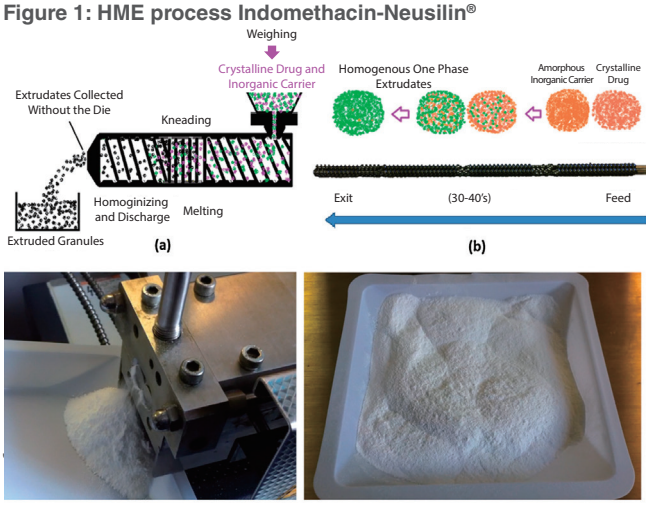
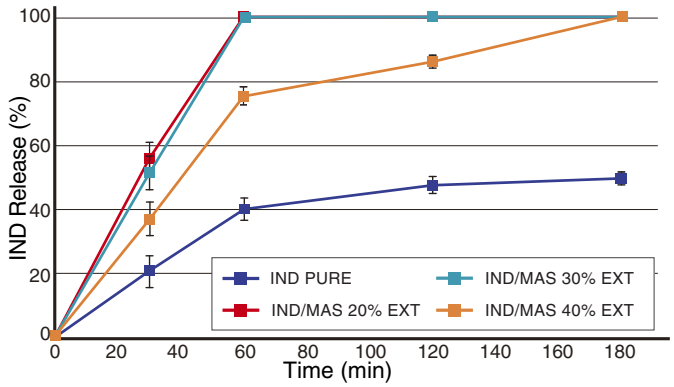


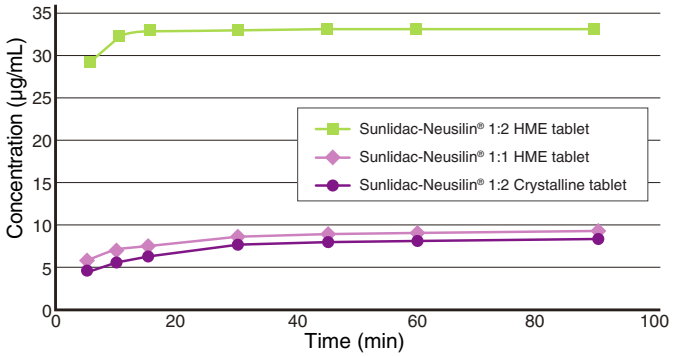
Figure 2:Indomethacin release from extruded formulations (n=3, paddle speed=100 rpm)



Hot melt extrusion of Sulindac-Neusilin® amorphous drug complex[2]

Blends of Sulindac-Neusilin® in 1:1 and 1:2 (w/w ratio) were prepared by mixing the components and charging them to the Brabender single-screw volumetric feeder that fed directly into the extruder hopper at 5% feed rate. The material was then extruded using a Prism PharmaLab 16 mm twin-screw extruder (25:1 L/D). The screw speed was set to 50 rpm for the duration of extrusion process. Conversion of the crystalline to amorphous complex was observed when HME was conducted at a temperature of 200°C, which is above the melting point of Sulindac. The sample was recovered as powder from the HME apparatus. The HME samples remained amorphous after 3 months of storage at 40°C/75% RH. The samples were found to remain amorphous for more than one year at ambient conditions. The HPLC analysis during and after the storage period showed no chemical degradation thus confirming the physical and chemical stability of amorphous phase. The stabilization of amorphous complex is an added advantage over other organic polymer excipients. Approximately 100 g of 1:1 and 1:2 Sulindac-Neusilin® complexes were produced in this experiment. Sulindac-Neusilin® complex powder recovered from HME was made into 100 mg, 200 mg and 500 mg tablets through direct compression. Sulindac-Neusilin® 1:2 HME tablet showed 100% release in 90 minutes as against 9% release of Sulindac-Neusilin® crystalline tablets[2] (Figure 3).

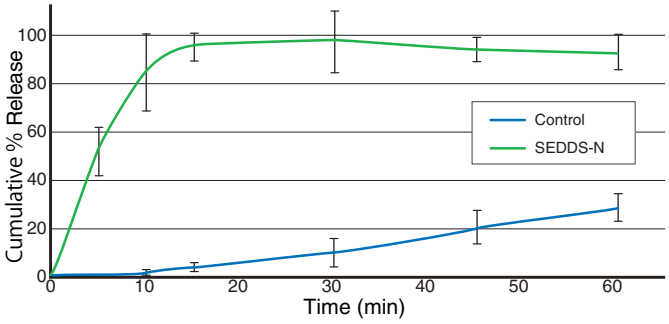
Figure 3: Dissolution profiles of HME Sulindac-Neusilin® Tablets



Neusilin® for transformation of Liquid SEDDS into Solid SEDDS

Neusilin® has very highly sphericity and porous structure with very high oil adsorption capacity. Such unique morphology of Neusilin® allow for easy conversion of lipid based liquid Self Emulsifying Drug Delivery System (SEDDS) into powder form without any additional step of drying and without any use of organic solvent.
There were numerous research work carried out to converts liquid SEDDS into solid dosage form. In one of research work[3], Paliperidone (9-hydroxyrisperidone, an active metabolite of risperidone a second-generation antipsychotic for the treatment of schizophrenia) has limited bioavailability of 28%. Paliperidone loaded SEDDS was formulated into solid SEDDS by adsorbing on to Neusilin® as carrier. The in vitro dissolution study indicates improved dissolution characteristics with higher dissolution efficiency for solid SEDDS (SEDDS-N) compared to pure drug[3] (Figure 4).

Figure 4: Dissolution profiles of Paliperidone drug vs SEEDS adsorbed on Neusilin® as carrier



In another research work[4], the liquid SEDDS of Lercanidipine hydrochloride was formulated into solid SEDDS as Self-Emulsifying Powder (SEP) by adsorbing on to Neusilin® as carrier. High dissolution efficiency value of SEP compared with pure drug was observed for final self-emulsifying powder formulation[4].

Figure 5: Dissolution profiles of pure Lercanidipine drug and SEP adsorbed on Neusilin® as carrier

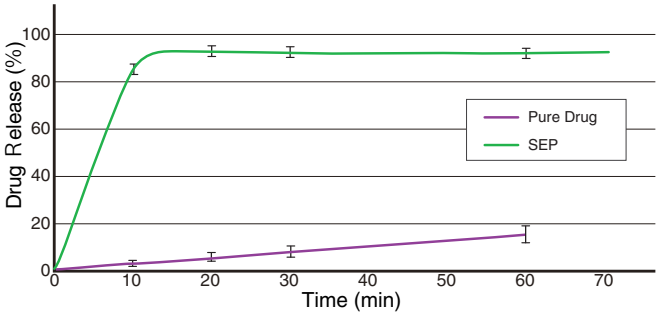
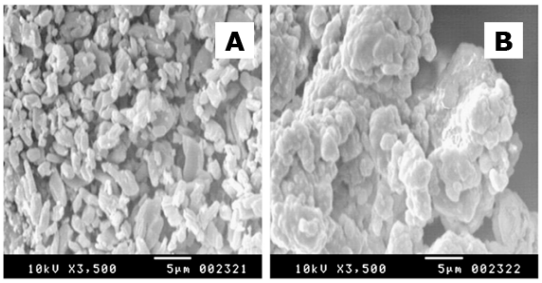


Figure 6: SEM image of A) pure Lecarnidipine drug and B) Solid Self Emulsifying Powder after adsorption on Neusilin®



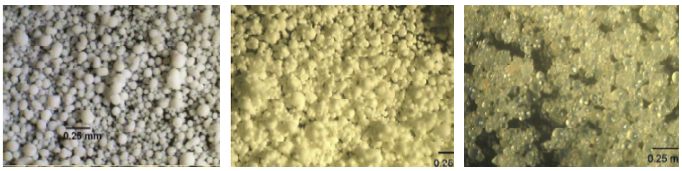
Neusilin® for tableting of herbal moisture sesitive extracts

Neusilin® UFL2 and US2 is used to convert oily extract into powder state. Most of the herbal extracts are obtained via extraction or distillation process of crude plant materials such as rhizomes, fruits, seed, stems, etc and such extracts are more prone to degradation during storage due to presence of moisture. Neusilin® has very high specific surface area and it is amorphous in nature, so it can easily convert sticky extracts into free flowing powder form which is then compressed into tablet or granules can be filled into capsule.

Neusilin® microencapsulation of essential oil

Neusilin® UFL2 and US2 grades have very high specific surface area, so it can easily entrap significant quantity of essential plant oil such as cinnamon oil or eucalyptus oil into his porous structure and convert oil into free flowing powder state[5].

Figure 7: Image of Neusilin® US2 at various amount of cinnamon oil loading; left 0%, middle 62% & and right after 78% loading



Neusilin® for cosmetic application

Unique properties of Neusilin® UFL2 make it an ideal component for cosmetic application. Usually, MAS is used as a thickner, Neusilin® does not develop viscosity or form gel. It is useful for formulation for various facial care products including lotions, eye shadow, cleansers, powders, acne and oily skin treatments and deodorants. Neusilin® works to eliminate odor in two ways: by neutralizing odor through making hydrogen bonds with bad odor components such as isovaleric acid or through covalent bonding with ammonia or trimethylamine. Moreover, superior oil adsorption capacity (330% of its own weight) makes Neusilin® as an ideal carrier for application including oily and acne care treatments.

References

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