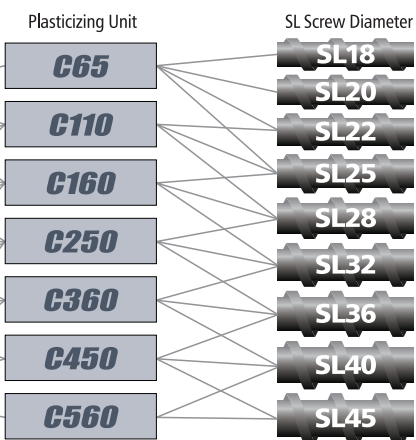


Machine Model and Plasticizing Module

SE-EV series

With SE-EV series machines (5 models ranging from 500 -- 1,800 kN), the SL Screw System is a standard option.



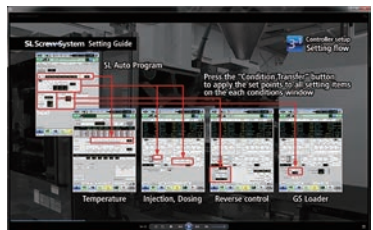
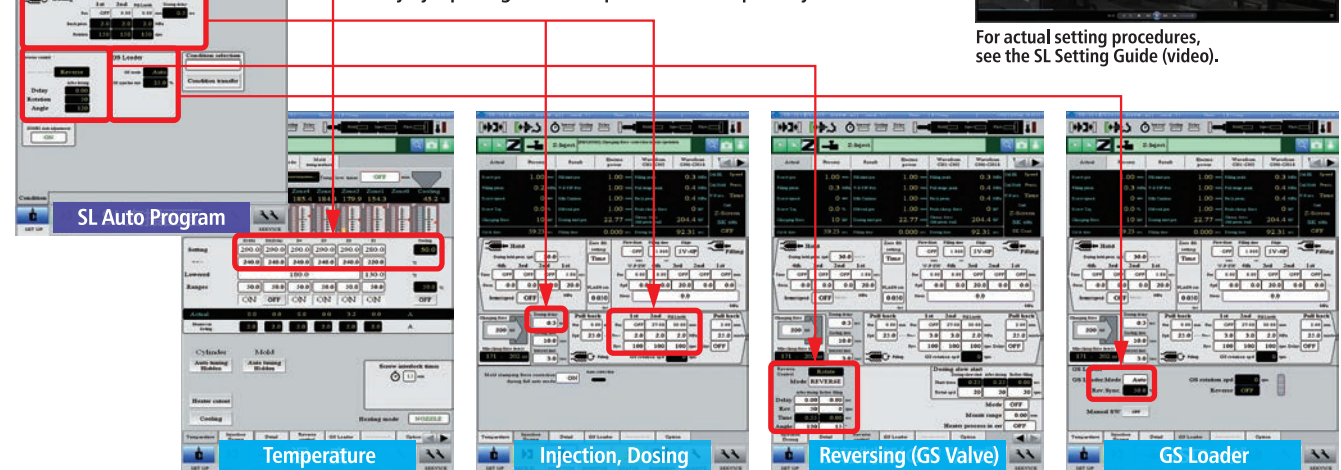
Can be retrofitted on existing machines

The SL Screw System can be retrofitted on other series electric molding machines with some simple modifications. For applicable machines and specifications, contact us.

SL Auto Program

"SL Auto Program" window as a standard feature on SE-EV series machines

By selecting a preset resin on the "SL Auto Program" window, system parameters are automatically set and applied to molding conditions. With unlisted resins, parameters can be automatically set in the same way by inputting the Z2 temperature from separately measured data.



For actual setting procedures, see the SL Setting Guide (Video).

Numerical data available by resin type and grade

Sumitomo can provide temperature data measured for resins and grades of currently popular engineering plastics. Also, if the data you seek is not available, we can measure resins for you on consignment.

Differential scanning calorimeter (Installed at SPIRAL LOGIC LIMITED)
Differential scanning calorimetry (DSC) measures the calorific difference between a target substance and reference substance. It is a method of thermal analysis for obtaining melting points (DDSC) or thermogravimetric (TG) curves.

Notes

Bear in mind the following when wanting to introduce the SL Screw System. For more information, contact us.

Resins that contain glass filler (GF)	For resins that contain less than 30% GF, choose the Wear/Corrosion Resistance II specification. For those with 30% or higher contents of GF, choose the Connector II or equivalent specification.
Corrosive resins (Halogen-free flame retardant grade)	Choose the Connector II or equivalent specification.
High temperature resins	For resins with melting points of 400°C or higher, choose the High Temperature specification. Also, for high temperature LCP, special accommodations are required.
Crushed material	Sizes of 4 mm or less are recommended. Plasticization can be unstable with virgin or crushed material larger than 4 mm in size.
Master batch	Mixing rates of 5% or more are recommended. With anything less than 5%, materials may not be adequately kneaded under some conditions.
Cycle time	Plasticization capacity is about 1/2 that of conventional screws. Therefore, under identical conditions, twice as much time is needed for plasticization.
Shot volume	When the plasticization stroke is twice the screw diameter or longer, the heater temperature may have to be set higher depending on the cycle and other conditions.
Hopper loader	The supply rate of the GS Loader can be affected by hopper loaders of high suction and transfer force. In this case, use a hopper with a flap valve.
Interference with nearby equipment	Because the screw assembly is short, the hopper may interfere with unloaders during nozzle touch.

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www.shi.co.jp/plastics/

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SL Screw System

SL Screw System



Elastomer

ABS

POM

PP

PA6

PC

PBT

PI

PPS (+GF)

PS

PMMA

PA6, PA66 (+GF)

PA6T, PA9T (+GF)

LCP (+GF)

MIM

Over-feeding occurs because of free falling and destabilizes metering. Moreover, soft pellets stick to the screw flight whereby throwing off plasticizing time. Plasticizing can be stabilized by constant rate feeding.

Material Matrix

This diagram shows how problems specific to individual resin states are solved when both pellets (solid) and melt (liquid) are simultaneously handled with a single in-line screw.

The cylinder wears down when the rotating check ring is used. When the non-rotating check ring is used, the screw head wears down and resin leaks. The hybrid check ring set that we developed by combining the rotating and non-rotating check rings ensures complete shutoff and durability.

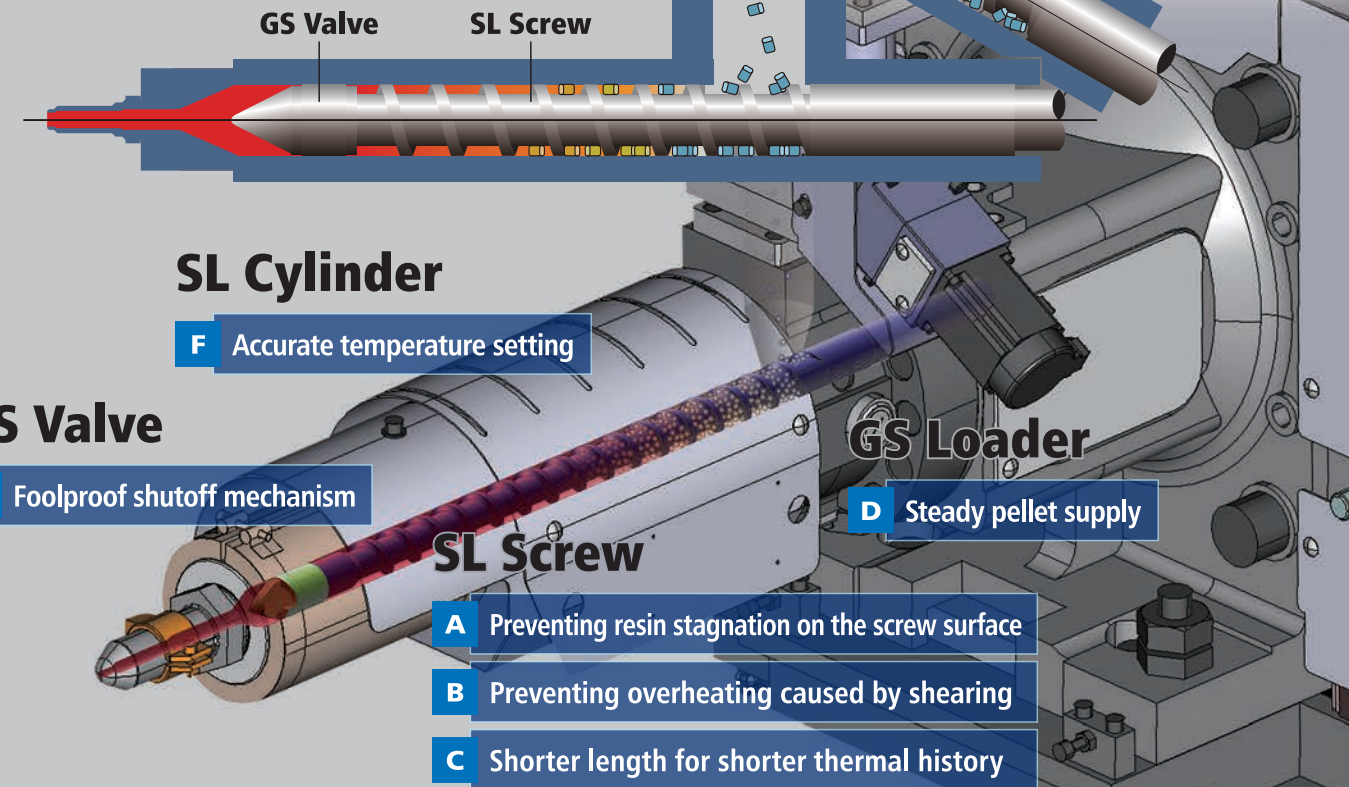
Because of over-feeding, pellets accumulate around the hopper feed throat. This results in pressure build-up and cylinder wear occurs. It also makes it difficult for moisture and gas to escape. Constant rate feeding eliminates any pellet accumulation in the hopper feed throat.

Melt transfers at a slower speed than pellets. Transfer gets even slower in the compression zone, which causes resin stagnation. A straight screw with no compression zone, a cylinder of high transfer performance and constant rate feeding enable smooth transfer.

System Configuration

Composed of 4 elements

The SL Screw System consists of a GS Loader for steady rate resin supply, GS Valve for preventing resin leaks and SL Cylinder of shorter length and enhanced transfer performance than conventional screws, around a core SL Screw of proprietary design.



GS Valve

E Foolproof shutoff mechanism

SL Cylinder

F Accurate temperature setting

A Preventing resin stagnation on the screw surface

B Preventing overheating caused by shearing

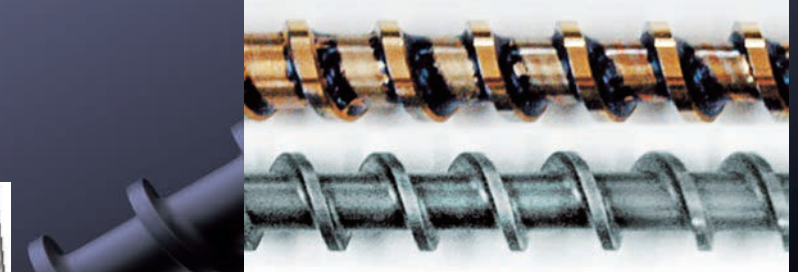
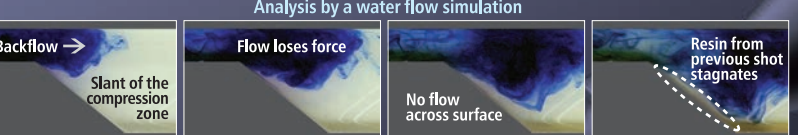
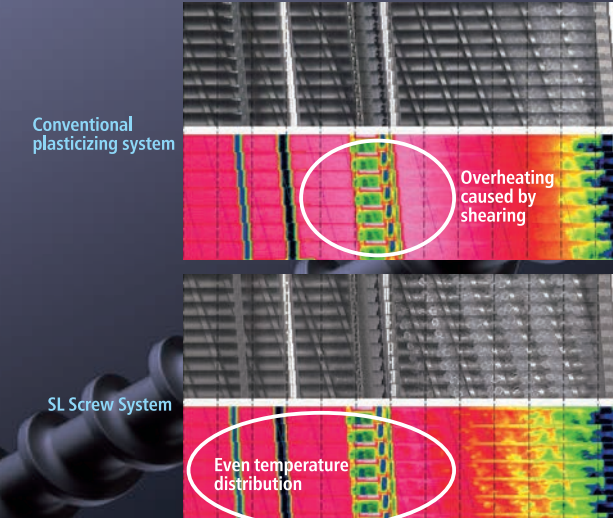
C Shorter length for shorter thermal history

D Steady pellet supply

SL Screw, the core of the system

A straight screw prevents resin stagnation and carbonization

With conventional screws, resin was found to stagnate and carbonize mainly in compression zones. According to the transport theory of viscous fluids, molten resin advances in the cylinder and, because of backflow, recedes on the screw surface. When the screw surface is inclined, the momentum of the backflow is lost because of the expansion of the space. A straight screw with no compression zones across its entire length keeps backflow moving instead of letting it recede on screw surfaces, making it hard for stagnant pockets to form.



Preventing overheating caused by shearing

With conventional screws, molten resin stagnates in compression zones, yet pellets are still fed from behind (hopper) without interruption. Strong force acts on the resin whereby causing shear heating. With the SL Screw System, the heat from the heater is efficiently transferred to the pellets as they are supplied at an appropriate rate, so they smoothly melt without resolidifying. Moreover, pellets melt at the set temperature and no overheating occurs.



Resin behavior was observed inside a cylinder with a sapphire glass window. Images at left were composed from images taken by a high speed camera (top) and infrared ray measuring device.

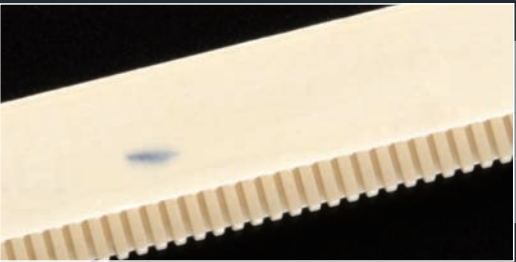
A theory rooted in intuition. A new stage in injection molding created by the SL Screw System.

Effectiveness of the SL Screw System understood in terms of what causes flaws

Defects and their impact on production

Black Spots, Burning and Yellowing

- Appearance flaws in products
- Increased screw maintenance



Gas Generation, Moisture Infiltration

- Appearance flaws in products
- Increased mold maintenance



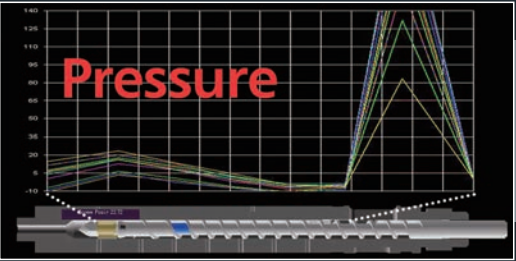
Cylinder Wear

- Increased cylinder and screw maintenance



Unstable Plasticization

- Unstable product accuracy



Causes and their mechanisms

Resin stagnates, carbonizes and contaminates products.

Resin decomposes under prolonged exposure to high temperatures.

Gas is generated by decomposing resin.

Moisture contained in resin cannot escape.

Cylinder wear occurs near the hopper feed throat because of the strong frictional force caused by an oversupply of pellets.

Plasticization process is unstable.

Intermittent short shots occur because of "unscrewing" (screw retraction phenomenon).

Keywords



Stagnation and Carbonization

Overheating

Thermal History

Oversupply

Shutoff

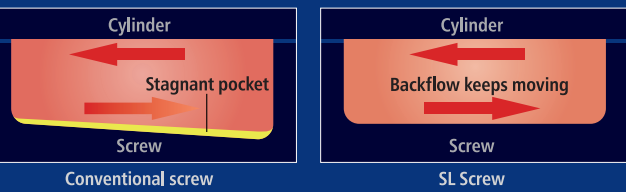
Temperature Control

Solutions with the SL Screw System

Screw design to prevent resin stagnation on the screw surface

A

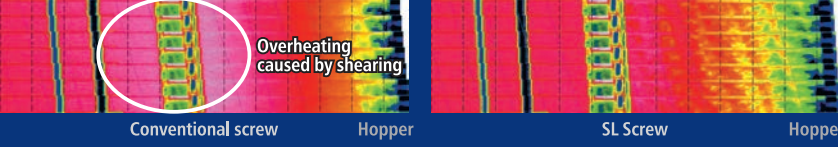
No compression zone resulting in elimination of carbonization of stagnant resin
A straight screw with no compression zone across its entire length keeps backflow moving instead of letting it recede on screw surfaces, making it hard for stagnant pockets to form.



Preventing overheating caused by shearing

B

Resin melting without destabilizing shear heat
Heat from the heater is efficiently transferred to the pellets as they are supplied at an appropriate rate, so they smoothly melt without resolidifying. Pellets melt at the set temperature and no overheating occurs.



Shorter screw length for shorter thermal history

C

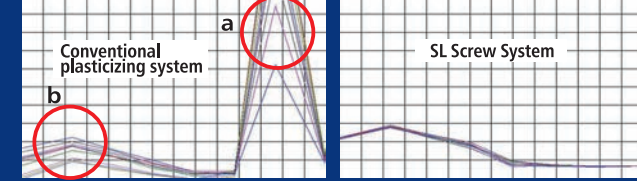
Owing to elimination of the compression zone and smooth resin melting
By eliminating the compression zone and efficiently transferring heat from the heater, the SL Screw was shortened to 2/3 the length of conventional screws. Because the screw is short, resin is not exposed to excessive heat, therefore its thermal history is shorter. This greatly prevents the resin from decomposing.



Steady pellet supply without excesses or shortages

D

GS Loader, developed for optimum pellet supply
An oversupply of pellets causes abnormal pressure to build near the hopper feed throat (a). This pressure causes "unscrewing" to occur. Resin pressure fluctuates greatly because of this unstable unscrewing (b). With an optimum pellet supply, pressure is stable for every shot without any spiking. With an undersupply of pellets, the flow of molten resin slows, which causes resin to stagnate on the screw surface even with straight screws.



Foolproof shutoff mechanism

E

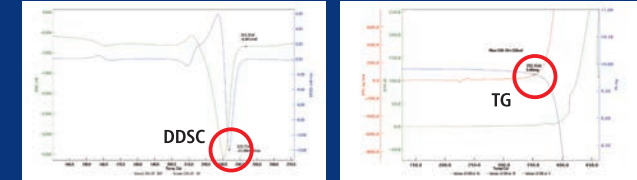
GS Valve, developed for assured sealing
This high performance tip set consists of a screw head, cam ring, check ring (rotating/non-rotating hybrid type) and seal ring. The GS Valve guarantees stable resin injection owing to good shutoff performance and durability.



Accurate temperature setting according to plasticizing melting point

F

Pinpoint temperature definition according to resin type and grade
With crystalline resins, the peak DDSC (time differential of DSC) obtained by differential scanning calorimetry is taken as the melting point. With non-crystalline resins, the high limit temperature is determined from the inflection point (reference) of a TG (thermogravimetric) curve. As such, heater temperature in each zone is accurately set according to the type and grade of resin, thus resins melt smoothly.



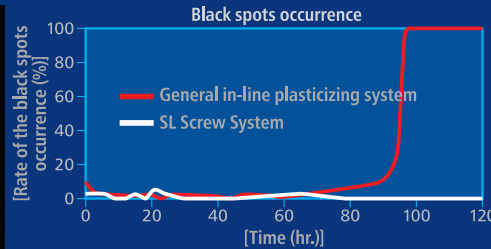
Examples of Effectiveness

1

No more black spots or yellowing with lenses



Eliminating black spots and yellowing caused by plasticization
The SL Screw System deters resin stagnation and carbonization, thus greatly reducing black spots. It also can prevent yellowing as resin is not overheated.



COP (ZEONEX E48R), 4 cavities, 0.7 g/shot, 19.8 sec

2

No more burning with PA products

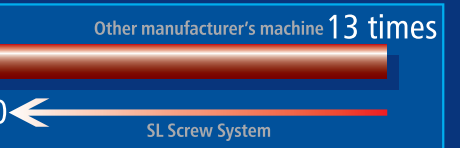
Burning of PA6T and PA46 products under high temperatures

With PA6T and PA46 resins that are molded at relatively high temperatures, burning (yellowing) occurs with products immediately after the start of mass-production. This is because the resin quickly hydrolyzes (carbonizes) in the cylinder under high temperature and high pressure.



PA6T (ARLEN), 8 cavities, 0.12 g/pc, 9 x 8 x t0.5 mm

Number of times production stopped due to burning (in 13 hr.)



Draining moisture that promotes hydrolysis

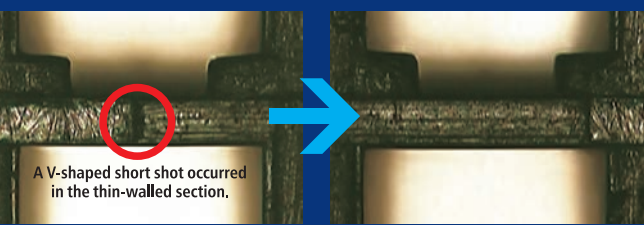
The SL Screw System does not generate shear heat, therefore the resin does not exceed the set temperature. Moreover, even if temperature and pressure inside the cylinder get relatively high, moisture in the resin is adequately drained from the GS Loader, therefore defects of this nature do not occur.

3

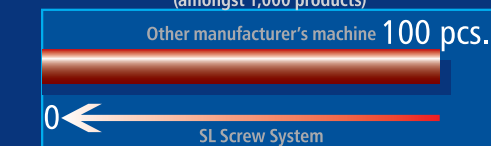
No more short shots with PBT products

Undrained moisture leads to short shots

When resin or additives hydrolyze, the generated moisture is injected into the mold along with the resin. If the gasified moisture is not drained and becomes confined in a thin-walled area where the resin is last injected, short shots occur.



Number of molded products where short shots occurred (amongst 1,000 products)



Designed to minimize hydrolysis and vent moisture
Because of its short thermal history, the SL Screw System does not overheat the resin, thus impeding hydrolysis and the generation of moisture. It also greatly reduces the formation of mold deposits, so it vents well and complete filling can be expected.

PBT (+GF30%), 1 cavity Photos: Courtesy of Tamagawadenki Co., Ltd.