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Screens and Screening in Extrusion

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Presented by Allan L. Griff, Consulting Engineer
301-654-1515
algriff@griffex.com

Moderated by Nathan Potter, IDES
800-788-4668 or 307-742-9227 x246
pottern@ides.com

What Are Screens & Why Do We Use Them?

Wire-mesh screens are used in almost all extrusions, to filter out contaminants and also to build up pressure in the extruder.

Pressure is both good and bad: it helps *mixing*, especially if screw rpm is high and the plastic isn't in the system very long.

However, more pressure may increase *melt temperature* coming out of the extruder, which could limit production rate.

Breaker Plates & Screen Sizes

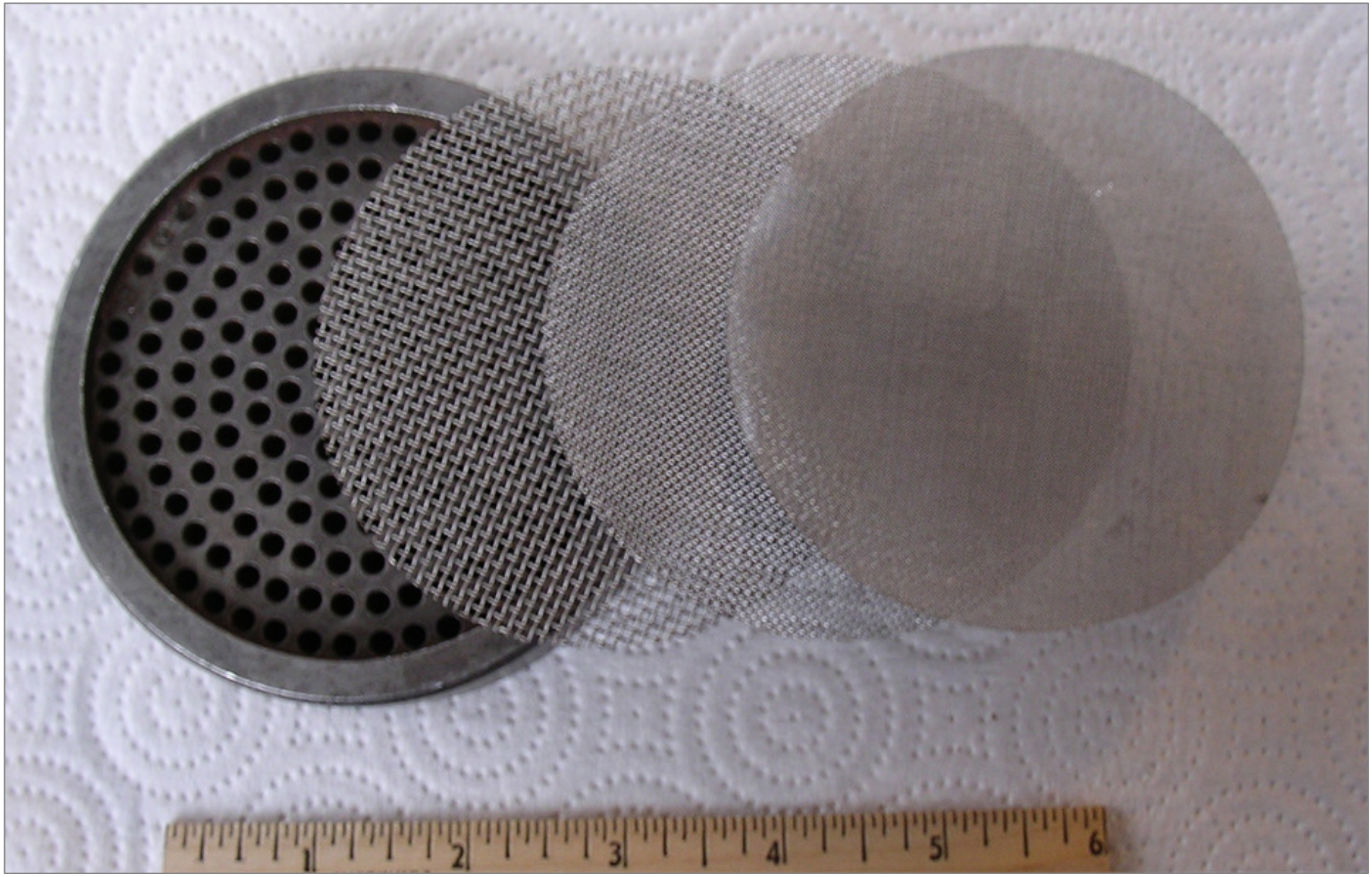
The screens are supported on a *breaker plate*, a perforated steel disk that also serves as the seal between the head section (die and adapter) and the extruder barrel. The holes are typically all around 0.125-0.25" (3-6 mm) in diameter, but unusual designs with several hole sizes and/or non-round shapes.

Screens are usually *square mesh* – that is, same number of wires per inch or cm in both directions. In most extrusions, a *screen pa*ck is used, made up of several screens. For example, a 20-mesh (20 wires per inch) is put up against the breaker plate, then perhaps a 40-mesh, then an 80 if that much filtration is wanted.

More on Screen Sizes

In *Dutch weave*, one direction uses fewer but thicker wires than the other. That makes a stronger screen with rectangular openings, and only one of these is usually enough.

Some very critical applications such as fibers, filaments and thin film use very fine screens, such as 200-350 mesh. Beyond this, there are 3-dimensional media such as sand beds, sintered metal, and other specialized systems that are common in synthetic fiber spinning but seldom used in conventional extrusion.



When to Change Screens

Watch the *pressure gauge*, which should be sensing pressure at the tip of the screw just before the screens. Set a limiting pressure, so that when it gets that high the screens are changed. This is a compromise between problems with high pressure (overheating, safety) and benefits of high pressure (mixing and less frequent changing).

Changing is done manually with small equipment, putting the screens into the end of the barrel such that they don't block the seal line; otherwise leakage will occur. Even with assisted screen changers, the operation should be manually initiated, as the time of change may need to be adjusted to match ends of runs, shutdowns or color changes.

When to Change, 2

Ideally, the pressure gauge should be set to flash a light or other alarm as the pressure is getting close to the limit, but this is seldom done, and the operators still need to watch the gauge.

If there is no working pressure gauge, screen changing must depend on something else, such as the motor, which will reflect higher pressure by drawing more current.

It is common to set a regular time, such as once a day, to change screens, but this may create problems if the contamination level varies substantially with time.

Don't forget the *wire gauge*. The same mesh size can have bigger holes if thinner wire is used, so once a size of screen is found to work well, make sure the same wire gauge is reordered as well as the mesh.

Sometimes screens are *doubled up* – two 40s or two 80s – to get a tighter pack. If that is done, set them at 45 degrees to each other, so maximum and consistent filtration capacity is achieved.

Order in the Pack

Although most screen packs are assembled with the heaviest screen next to the breaker plate, a few operations do it the other way round, and that works too.

Proponents of the first way, heaviest next to the plate, say that the heavier screens support the finer ones and prevent their blowing through from the differential pressure.

The others note that if the fine screen is next to the plate, the coarser ones catch most of the contamination, so the pressure drop across the finest one stays low, hence no blow-through.

Sandwich Packs

Some packs are actually sandwiches, with a coarse screen on both sides,

partly to protect the finest screen that otherwise might be exposed to the rotating flow of the melt just coming off the screw, and

partly to make a symmetrical pack which can be put in either way with the same result.

When to Use a Screen Changer

Screen changers reduce the downtime required to do this job.

For a small machine (2.5” diameter or less) it is a relatively simple and quick job to open the head and replace the screens – maybe 30 minutes to an hour.

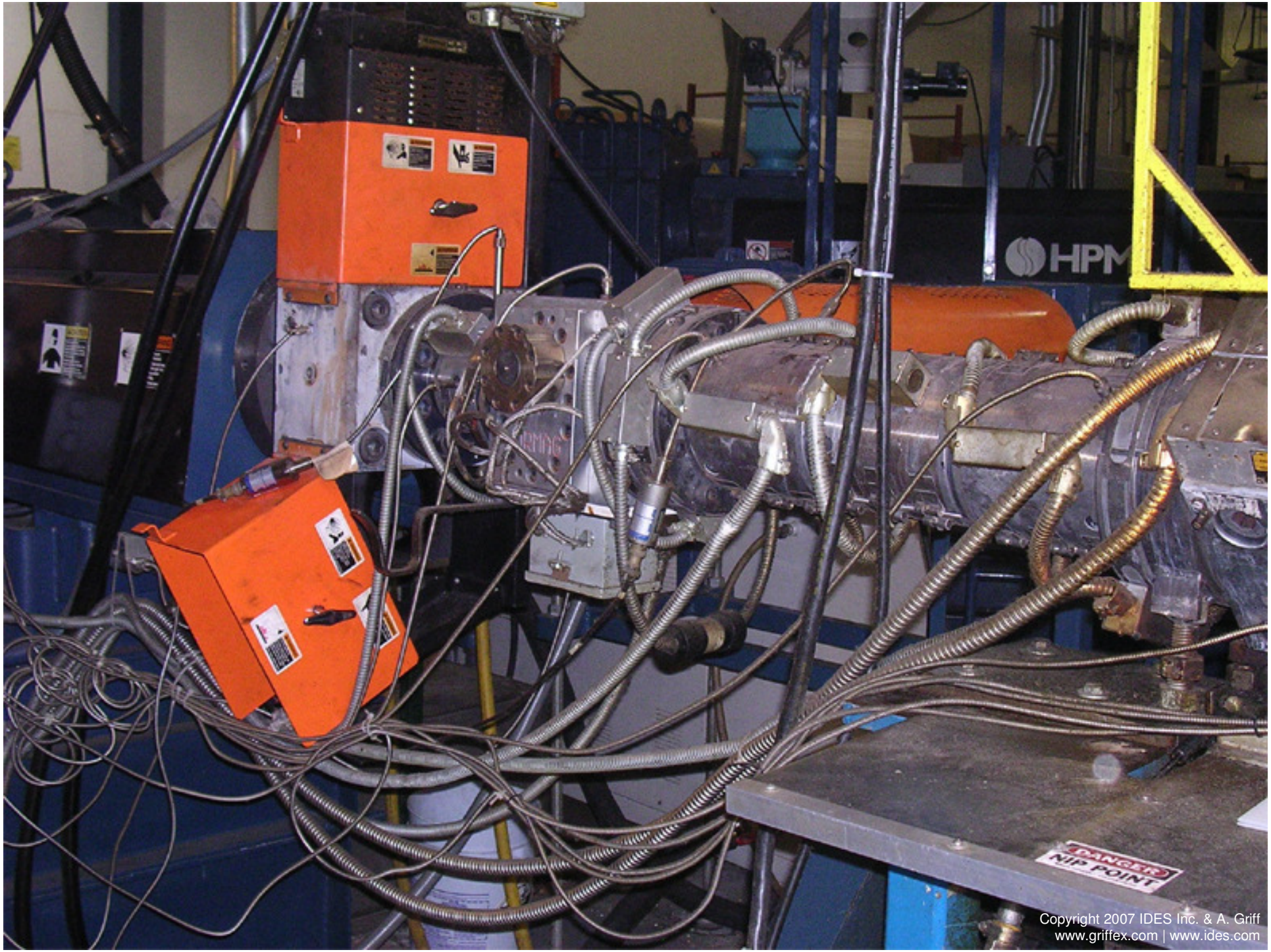
For bigger machines, or lines where opening the head is not so easy, a changer is preferred. And where recycled material is being used and contamination levels are high, the changes are much more frequent and the value of a changer is higher.

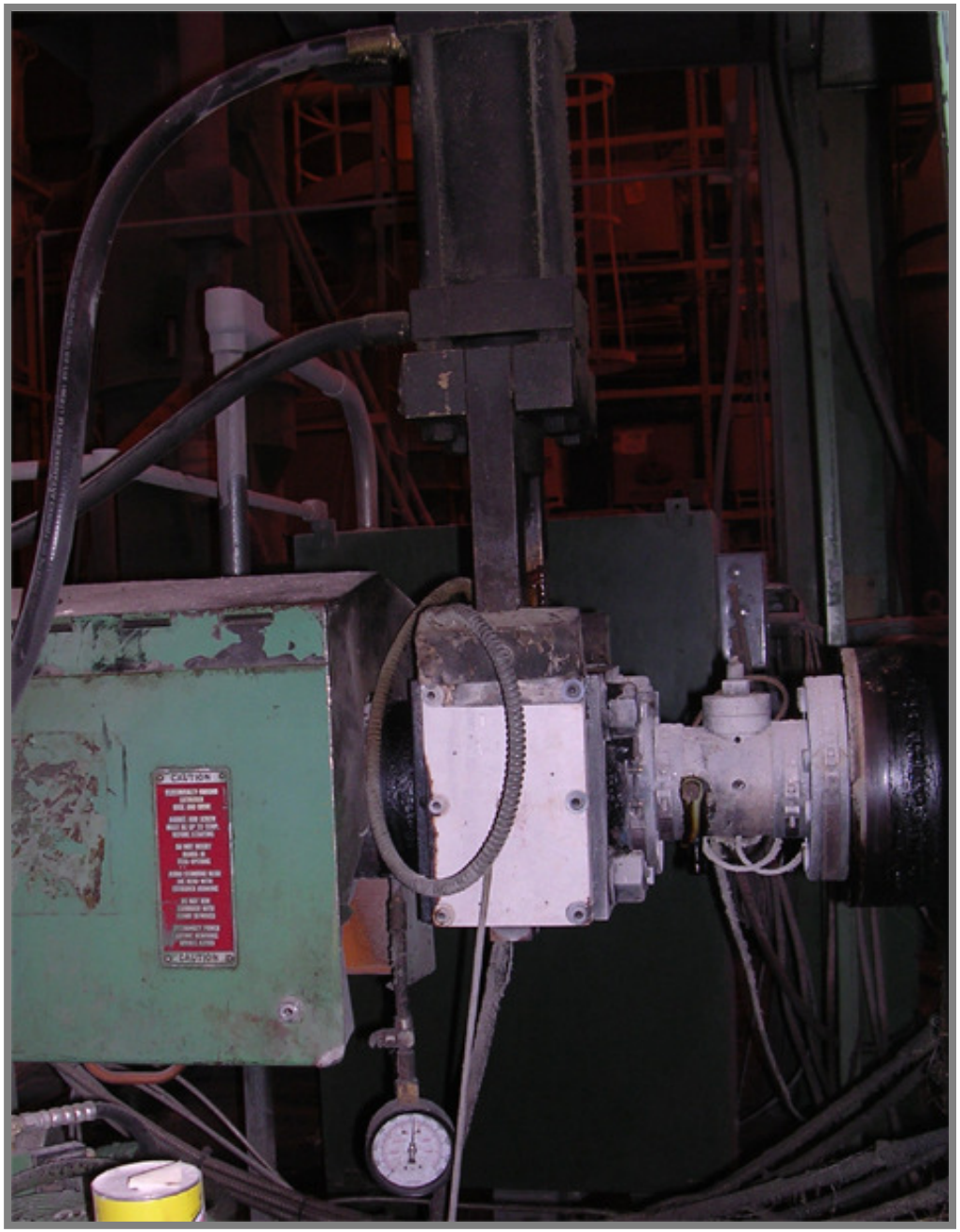
Types of Changers

Lever changers – there are two plates with screens, one in service and the other waiting to be used. The line is stopped and a lever pulled to bring the used one out and the clean one in. Then it is bolted tight again. This is the least expensive changer type.

The next type is the **slide plate** – the principle is the same as the lever, but the plates/screens slide in and out of position on a track (some horizontal, some vertical).

Both these systems should have two plates available, so the line doesn't stay down while the old one is cleaned.





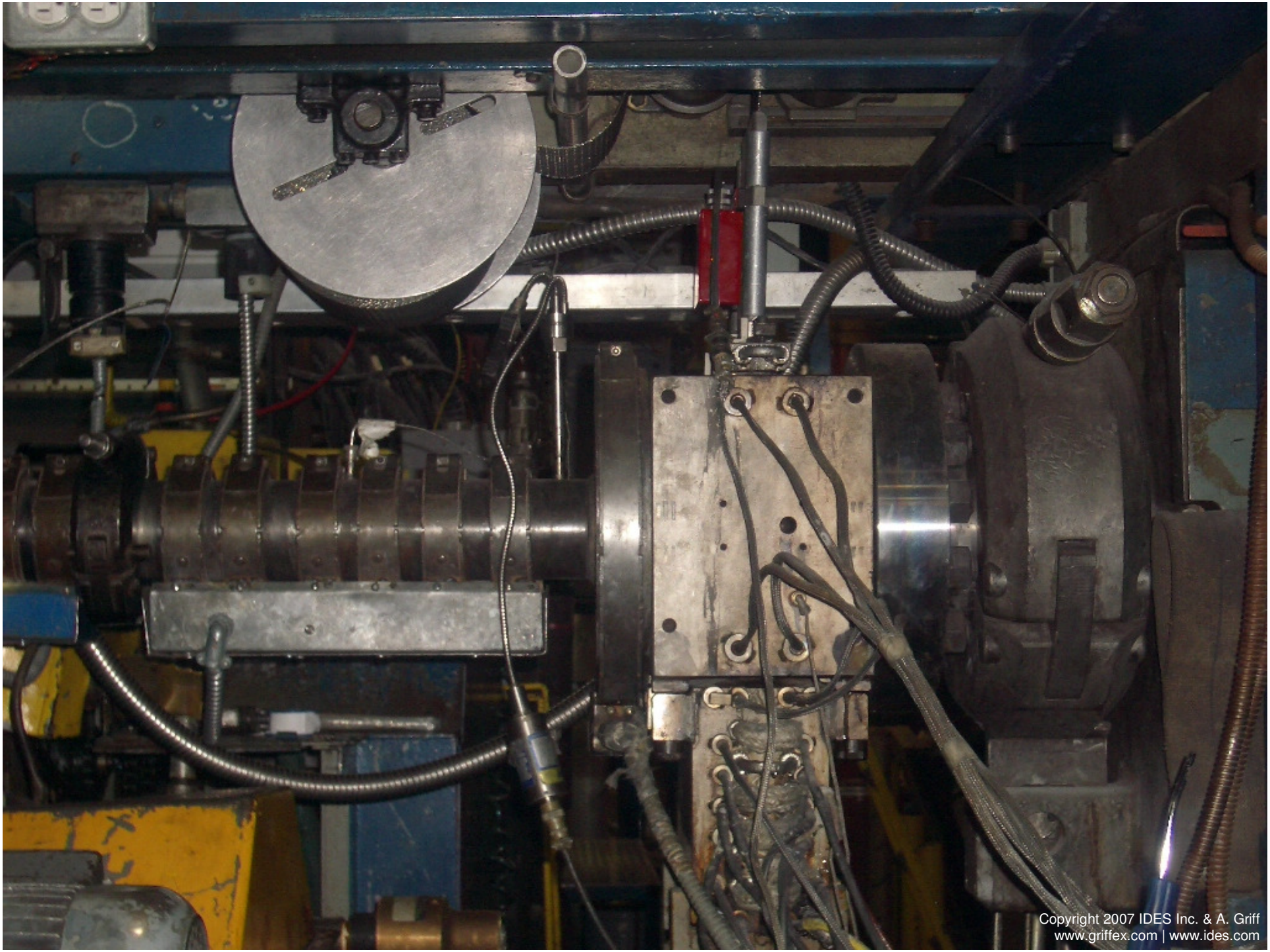
Some slide-plate changers require the line to be stopped during the change, but many can be operated “on the fly,” with some production time lost to account for the lower back pressure (either slowing down the screw or speeding up the takeoff).

For these systems, it is good to have a pre-fill option, where the new plate and screens are pre-filled with melt just before pushing them in place. This avoids pushing air into the system, which might cause trouble or even breakage of the continuity of the product.

Continuous Changers

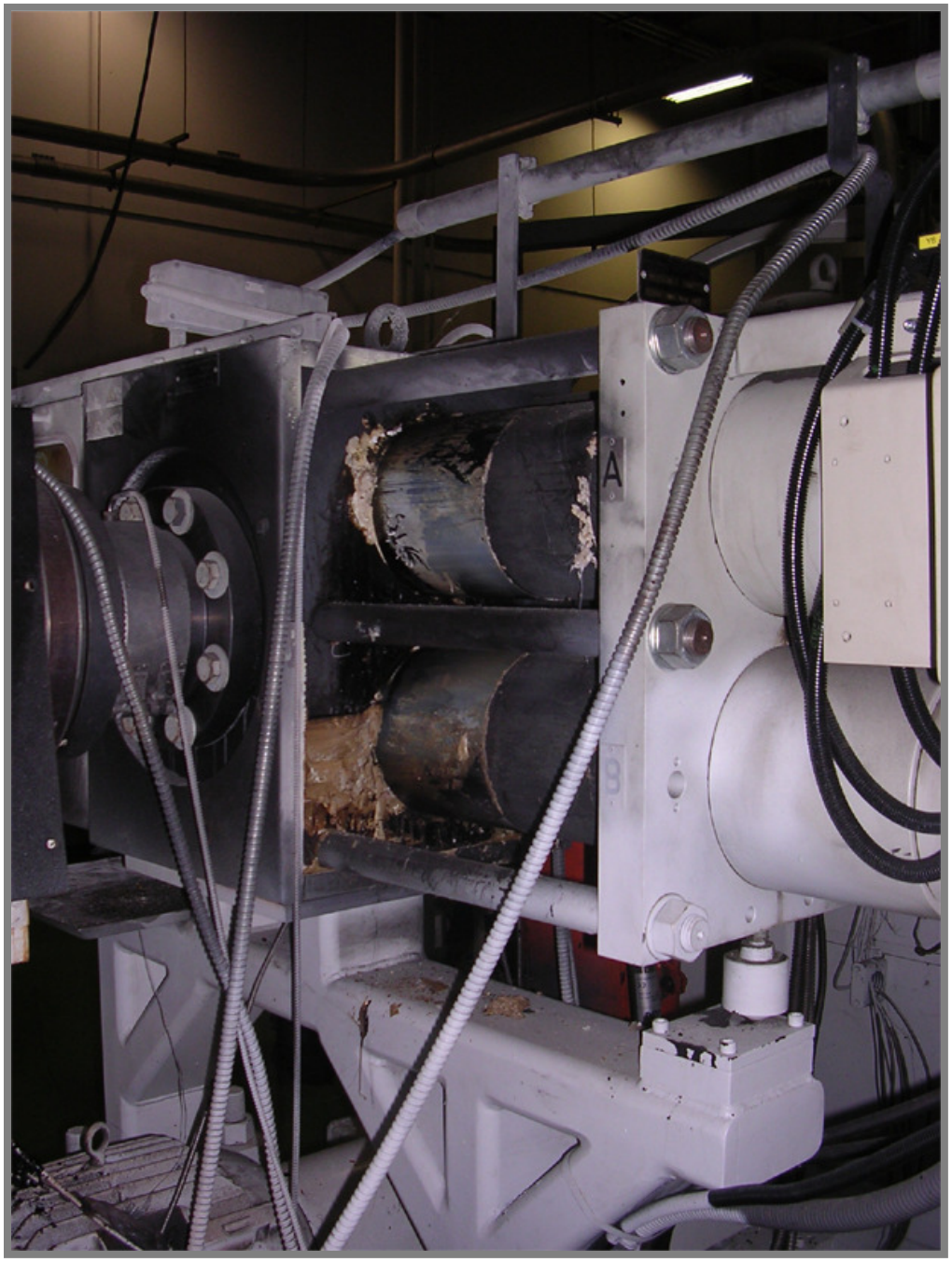
The rotating wheel contains a number of plate positions (8 or 12) and the wheel is indexed into position when a new plate-screen combination is needed. This works with round screens but still must account for the pressure change when the new screens are in.
However, some have screens in D or pie slice shapes, which are placed so close that the wheel turns slowly but continuously, always bringing clean screen into the flow path to maintain near-constant back pressure.

The **strip changer** works differently: a coil of screen passes across the flow path, and as it leaves the other side it is frozen by the temperature-controlled chamber it must pass through. It is thus embedded in the "plug" and thus pulls the screen in from the other side. Nothing moves except the screen itself.



Dual-path screeners split the flow between head and die, and each of the split passages has its own plate and screens. When one screen pack needs cleaning, the flow is diverted through the other passage and screens can be changed. Screw speed may have to be adjusted to hold production rate, but it is still better than stopping all the flow at once.

Self-cleaning Changers have an internal moving passage sweeping the upstream side of the screen pack and venting out to the air. The internal pressure forces the melt backward through the screens and pushes out the collected contamination.



Screen Materials

Most screens are conventional steel, but that requires attention to keep them from rusting in storage, which would mean more chance of blow-through when used. If relatively clean materials are used (hence fewer changes), stainless steel is used and their added cost is justified by the reduced worry about rusting.

Special metals, usually nickel alloys, are needed for extrusion of PVDC and some fluoroplastics, not only for screens but for the entire interior of the system, as these resins are too corrosive for regular steel or even stainless steel under extrusion conditions.

Screens are almost never re-used, although in principle they can be cleaned and put back. However, they may get distorted or broken in removing them, and if put in backward (compared to the first use), contaminant particles lodged in between the wires get driven forward out into the product.

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Thank you for attending today's webinar!

Allan Griff, Consulting Engineer
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www.griffex.com

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