A properly balanced size-distribution in the abrasive work-mix is the key to effective and efficient blast cleaning. Thus, need for screen analysis of the work-mix on an on-going basis is obvious.

Likewise, because proper operation of the blast unit’s separator system is essential to maintaining a proper work-mix, the need for screen analysis of the abrasive contained in the separator discard is equally obvious.

The objectives of the screen analysis are:
1. To determine whether the abrasive work-mix is in proper balance for effective cleaning.
2. To determine whether harmful contaminants are being removed from the work-mix.
3. To determine whether usable abrasive is being wasted because of improper separation.

By not monitoring and controlling this key part of the blast cleaning operation, a firm is on a fast path to losing its competitive edge:

- Cleaning costs can skyrocket — go completely out of sight.
- Quality of finish — the very reason for blast cleaning — can deteriorate rapidly and make for unhappy customers.
- Productivity in the cleaning department can fall off severely and bottleneck the flow of finished product out the shipping door. That leaves everybody unhappy.

How can an abrasive user afford not to spend the very few minutes per blast unit, per week, required to make these screen analysis to know whether or not his operation is on track?

**THE POTENTIAL PROBLEM AREAS**

The self-destruct characteristics of the blast cleaning system, particularly with respect to the blast-wheel components and the separator system, makes it mandatory that the work-mix and the separator discard be screen-analyzed frequently, preferably twice a week. The screening procedure can represent just a few minutes time spent for tremendous benefit in both control of surface finish quality and control over operating costs.

In addition to the work-mix and separator discard abrasive, these potential problem sources should be checked regularly:

- The scalping system and coarse refuse discharge.
- The expansion-trap dribble pipe material should be checked for evidence of excessive quantities of usable abrasive.
- The dust collector system — is usable abrasive reaching the dust collector hopper?

**WORK-MIX SCREEN ANALYSIS RESULTS — GOOD? BAD?**

Work-mix guidelines are needed, against which actual screen analysis results can be measured. Comparison with the guideline parameters will tell whether a given work-mix is too coarse, is too fine, or is just where it belongs. (Guidelines for the various shot and grit sizes are listed in Ervin’s Technical Bulletin of 8/3/84. For a copy, contact Ervin Industries at 1-800-748-0055 or (734) 769-4600.)

*Continued on Page 3*
SEPARATOR DISCARD SCREEN RESULTS — GOOD? BAD?

First, you must determine (by trial and error) the smallest size abrasive particle that can be retained in the work-mix, without also retaining sand or other harmful contaminants.

Once this determination has been made, common-sense dictates that very little (no more than 3% to 6%) of that smallest abrasive size should be found in the separator discard material, and most certainly, none of any of the larger sizes should appear in the separator discard!

The same common-sense rule applies to the screen results of abrasive material found in the dust collector hopper, the expansion trap, and the scalp/coarse refuse discharge: If the abrasive size belongs in the work-mix, it does not belong in the dust collector hopper or the scalp/coarse refuse discharge. It's as simple as that!

Since the expansion trap is intended to be a safeguard against usable material reaching the dust collector, some usable material may be expected to be found in the expansion trap dribble pipe — but, it should not be excessive, even though it is being returned to the system. Finding an excess flow of usable material at this point is a clear-cut indication of malfunction at the primary separating point: the separator.

SAMPLING PROCEDURES

Obviously, great care should be taken to insure that the samples obtained are as representative as possible of the material and the operating conditions being evaluated. The recommended procedures for obtaining samples for screen analysis are outlined in detail in Ervin’s Technical Bulletin dated 3/30/84. (For a copy, contact Ervin Industries at 1-800-748-0055 or (734)769-4600.)

SOME GENERAL COMMENTS ON SCREENING

Common-sense should prevail in the screening procedure. Do it right but don’t overkill and waste time and money. Overkill can make what should be a simple and easy task very complicated and cumbersome, thereby discouraging use of this most important test for control of the blast cleaning operation.

Recognize that, even at best, you are dealing with fractional-pound grab-bag samples taken from a system that often involves tons. Therefore, we don’t need to screen to the fourth decimal - rounded number percentages will tell the story well enough.

Recognize too, that the work-mix undergoes size-distribution change constantly, from addition to addition. The separator discard also changes from the beginning of the cycle when contamination content is heaviest, to the end of the cycle when contamination is lighter. Samples that necessarily must be obtained under such conditions must be recognized as being somewhat variable. Thus, the work-mix screen results are critical only in terms of being within the parameters shown in the Work-Mix Guidelines for the respective size and type abrasive being used. For example, when checking the coarse (original size) portion of the work-mix vs. a Guideline range of 30% to 50%, the important thing to know is whether it falls within that range...not that it’s 37.1234% or 61.1234%. The round figure (37% or 61%) tells all that is needed to know.

For those users with complete laboratory facilities, the inclination to screen strictly according to the many published ASTM standards relating to the sieve analysis of materials, may prove to be irresistible. We would not wish to discourage this, but we would like to make these points:

- Too often, the time involved in getting samples to the laboratory facilities, and then awaiting lab priorities, results in feedback being received in the cleaning room too late to be truly helpful.
- Too often, we find that feedback never reaches the cleaning room operators or maintenance. We've seen as much as 6 months of lab screen reports that clearly were signaling “problems exist”, except that when neatly filed in a lab book, and not fed back to operations, those signals didn’t lead to response or to coping.)
- Too often, on the other hand, we've found instances where cleaning room operators, having supplied samples to the lab, felt their involvement with the sample and its screen results was over.

If the cleaning room supervisor is aware of the above potential problems, steps can be taken to avoid them, and using existing laboratory facilities makes good sense. ASTM standards for sieve analysis are most comprehensive, and this Technical Bulletin sheds very little additional information relative to screening procedures. But, remember, don’t overkill.

However, the main thrust of this Technical Bulletin is:

- To encourage cleaning room management to utilize the screen-analysis process to improve and control blast cleaning effectiveness and efficiency.
- To suggest a simplified screening procedure (not as complicated and exacting as ASTM procedures) that provides the essential data and will be sufficiently convenient and easy to do, that it can and will be done.
- To suggest it is possible to bring the screening function into the cleaning room, where problems originate, and where they must be solved.

By setting up a screening station in the cleaning room, the time-phase between problem-identification and problem-solving is shortened dramatically. The operator can be on top of his operation at all times. Good, effective operators much prefer being in constant control of their operation by this method, as opposed to having to wait for screen results from an already overworked lab.

Screening at the point of operation is standard practice in steel mills with up-to-date practices in the rolling mill, where hard steel rolls are etched with steel grit to impart a closely defined and critical anchor pattern that is later transferred, in the rolling process, to the final sheet product, for optimum paint or coating performance. Roll-etch operators perform work-mix screen analysis during each shift, tying the results in with the etch attained. Thus, the operator can make correction as and when needed — before the next roll is blasted. That is constant control. That should be your goal. Be sure the work-mix is right!

TEST SIEVES, ACCESSORIES, AND SCREEN PROCEDURE

Test sieves manufactured by CE-Tyler are recommended, and can be purchased direct or through Ervin Industries, Inc. Table I lists the sieves available for screening the work-mix and separator discard samples. The full-height 8-inch (203 mm) diameter sieves are standard, but for the recommended small quantities of abrasive to be screened, the half-height screens are equally effective, with the advantage of being able to stack more screens when using a
Table I.

<table>
<thead>
<tr>
<th>USA Standard Sieves</th>
<th>Shot Sizes</th>
<th>Grit Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesh Opening</td>
<td>0.0015&quot;</td>
<td>0.0030&quot;</td>
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<tr>
<td>7</td>
<td>0.111&quot;</td>
<td>0.0953&quot;</td>
</tr>
<tr>
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<td>0.0993&quot;</td>
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<tr>
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<td>0.0953&quot;</td>
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<td>0.0953&quot;</td>
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<td>0.0953&quot;</td>
</tr>
<tr>
<td>200</td>
<td>0.0029&quot;</td>
<td>0.0953&quot;</td>
</tr>
</tbody>
</table>

$x =$ minimum number of screens recommended for work-mix screen analysis, according to size of SAE shot or grit purchased.

Dimensions of Standard 8" Diameter Testing Sieves

**Figure 1.**

mechanical shaker, and being easier to work with when screening by hand. (See Figure 1.) We recommend standard stainless frames with stainless wire cloth, when available. (The 3-inch screens used by Ervin's representatives are not recommended — they are much too slow for constant use — and have to be handled with extra care to get accurate results.)

For sieve analysis of the work-mix, use a sample weight of at least 100 grams, but not more than 200 grams. Use of a polystyrene graduate, (1-inch diameter) with a 50 Ml capacity, graduated by 1 ML markings, is easy and fast to work with, and gives results accurate enough for this purpose. A graduate filled to the 50 ML level will contain close to 200 grams — a 25 ML graduate will contain approximately 100 grams. Use of a graduate eliminates the cost and problems involved with use of a scale. Obviously, use of a good scale can produce more accurate results — but, again, for our purposes the readings do not have to be all that precise.

**REDUCTION OF GROSS SAMPLE TO TEST SAMPLE**

When you are obtaining work-mix or separator discard samples from the blast cleaning equipment, you should be more concerned with obtaining a representative sample than how much it weighs. Thus the gross sample may be considerably more than the 200 gram (50 ML) maximum lot for screening; particularly the separator discard sample because it should contain mostly, if not all, contaminants, and it is the abrasive content that is wanted for screening.

After the gross sample has been properly taken, the next step is to reduce it to a suitable size for the sieve analysis test, without impairing in any way the particle size-distribution characteristics of the original sample. This phase of the operation should be performed with as much care as should be used in the collection of the gross sample.

Coning and Quartering - Pile the gross sample of work-mix in a cone (Figure 2). Pour the sample onto the apex of the cone and allow it to run down equally in all directions. Spread the sample in a circle, work around the circle gradually widening the circle until the material is spread into a uniform thickness. Mark the flat pile into quarters, and reject two opposite quarters. Mix the remaining two quarters again into a conical pile, taking alternate portions from the two quarters. Continue the process of piling, flattening and rejecting two quarters until the sample is reduced to the 50 ML or 25 ML quantity to be tested.

**Figure 2.**

Sample splitter - Gross work-mix samples, if not too large, may be reduced to test sample size by one or more passes through a sample splitter or Jones type riffler, (Figure 3), which will divide a sample in half while maintaining the particle size distribution of the original sample. By repeated passes, the sample can be split until the size of the sample equals 200 grams, (50 ML), or 100 grams, (25 ML). This method is fast and effective.

**HAND SIEVING METHOD (Figure 4)**

Procedure With a Stack of Sieves - In hand sieving, when a number of sieves are to be used in the test, arrange the sieves in a stack with the most coarse sieve at the top, with subsequent sieve openings positioned below, in order, including the bottom pan. Place the sample to be sieved on the top sieve. Place cover on the
top sieve. Give the whole stack of sieves a preliminary shaking for 2 minutes. The most practical way to do this is to place the stack on a table and shake the sieves with a circular motion accompanied by a tapping action. After this preliminary shaking shake each sieve separately, starting with the most coarse, to complete the separation. Add all material passing through each individual sieve to the next smaller sieve in the sequence.

When shaking each screen separately, shake until little or no material passes through. Check the sieve to be sure it is not plugged/blinded. If it is blinded, remove and set aside the material resting on the sieve, turn the screen upside down then gently tap the side of the screen with the handle of a wire brush used for cleaning sieves — then brush the sieve to dislodge any retained particles. Then re-screen the material set aside until little or none passes the sieve.

MECHANICAL SIEVE SHAKER METHOD

Mechanical sieve shakers are used in practically all laboratories where frequent tests are made. The Tyler Ro-Tap Testing Sieve Shaker is most commonly used. However, if a mechanical sieve shaker is to be purchased just for checking abrasive work-mix and separator discard samples, we recommend the Tyler Portable Sieve Shaker. It is much less expensive, has the advantage of portability, and is perfectly satisfactory with respect to accuracy and consistency of results for purposes of work-mix and separator discard analysis. (Figure 5).

Time of sieve-shaking is of paramount importance. Ten minutes of mechanical shaking is usually sufficient for up to 200 grams (50 ML), and in some cases, particularly the larger sizes, five minutes may be sufficient. Trial and error will determine the best time for you. Do not go less than five minutes - you may save time, but you will usually defeat the purpose of the screen analysis.

CALCULATION OF SCREEN ANALYSIS RESULTS

Measure the material finally retained on each sieve by volume (in the graduate) or by actual scale weight. The sum of the material retained on all the various screens and the pan is to be used as 100 percent for calculation of the sieve analysis percentages.

List the individual percentages shown for the material shown on each sieve on the Blast Cleaning Operations Analysis Chart. (For a copy, contact Ervin Industries at 1-800-748-0055 or (734)769-4600.) For work-mixes, when contaminant is present, estimate the percentage of contaminant on each sieve. Non-magnetic contamination in the separator discard should be removed prior to screening. Estimate the percentage of metallic contamination on each sieve (it can be distinguished from abrasive particles, under magnification).

Interpretation of the results must relate directly to these objectives:

- Is the work-mix in proper balance for effective cleaning? Is it too coarse? Is it too fine?
- Have contaminants been removed from the work-mix?
- Has usable abrasive been lost from the system because of improper operation of the separator system?

HOW MANY SCREENS SHOULD BE USED? WHICH ONES?

Table I not only lists all the standard test sieves regularly available, but also gives you two choices of the number of screens to use:

1. For a given size, you can use all the screens listed starting at the top with the test sieve that represents the SAE “All-Pass” or 5% or 10% Max Top” screen opening. Thus, for SAE S-660 the top screen will be 0.0937” — for SAE S-330 the top screen would be 0.0469”.

Then, you can use all the screens listed on Table I from 0.0937” and below for S-660 — and from 0.0469” and below for S-330. Use of such full sets actually tells you more than you need to know, and having too many screens adds to the time of making the analysis. Yet, some users will prefer full sets in case they decide to change sizes at a future date.

2. Table I also contains a chart which shows the minimum number of test sieves that can be used for the purposes of the Operations Analysis. The chart is arranged according to size of SAE shot or grit purchased. Use those screens marked “X”.

In each case, the test sieve that will be at the top of the stack will have a screen opening equal to that of the SAE designated “All-Pass” or “Max Top” screen for the respective size/type abrasive purchased. This screen immediately spotlights the presence of over-size materials.

The second screen in the stack will be a test sieve equal in screen opening to the SAE “Nominal Retained On” screen. The material that passes through the first screen and is retained on this second screen represents the “original size” referred to in the 8-03-84 Technical Bulletin (Ervin Industries at 1-800-748-0055 or (734)769-4600.)

The third screen has been selected arbitrarily as being approximately half the size of the screen opening of the “Nominal Retained On” screen. Material on this screen represents the mid-sizes in the work-mix.
Below the mid-size screen, several screens are used, down to
the test-sieve that matches the cut-off point desired in the separator
system. Use of this series of screens not only enables you to deter-
mine whether the "Fine Size" is within the Guideline parameters—
but it also tells you exactly where the actual cut-off point is. This
information is helpful in making the proper adjustments in the
separator settings.

INSTANT WORK-MIX ANALYSIS — KNOW NOW IF THE
OPERATION IS IN TROUBLE

The advantage and the tremendous importance of obtaining fast
and at-the-point-of-operation screen analysis of the work-mix can-
not be overstated. You can know NOW whether the operations is as
it should be - if it's not, you can start tracing the causes, and start
making corrective measures - NOW.

Fifteen minutes maximum, plus 3 screens and a pan, and a 50
ML graduate (1" diameter), are all that's needed to make this
INSTANT check.

The top screen to be used is the "Nominal Retained on" screen
for the new size purchased. The second and third screens are top
and bottom screens of the intended "Fine Size" in the work-mix, as
shown under (a) or (b), Fine Size, in the Guideline section of the
Blast Cleaning Operations Analysis Form. (For a copy, call Ervin
Industries at 1-800-748-0055 or (734) 760-4600.)

EXAMPLE: S-550 Shot Guideline Range
On nominal screen (14 M, 0.0555") 25% to 45%
Thru second screen (30 M, 0.0234") -
On third screen (40 M, 0.0165") 5% to 15%

For the INSTANT check, mark the graduate with a marker-pen
to show the 100% level, (50 ML); mark a band to represent the
25% to 45% range; and mark a third band representing 5% to 15%.
Fill the graduate to the 100% level, then hand-screen the work-mix.
Pour back into the graduate the material retained on the first screen
- if it's above or below the 25/45% band, the work-mix is out of
balance. Check to see how the "Fine Size" material compares to the
5% to 15% band.

If the INSTANT check indicates an out-of-balance work-mix,
then take a second sample, and put this material through the full
screen procedure. If the problems are confirmed, it's time for
problem-solving.

CONTAMINANTS IN THE WORK-MIX SAMPLE

Contaminants such as sand, ceramics, oxide scale, etc. don't
belong in the work-mix. Fine-size contaminants such as these
impose tremendous wear on the blast wheel components, causing
high maintenance/replacement costs, and causing costly down-time.

The blast unit’s separator system has the challenge of extracting
these contaminants from the work-mix, without undue loss of usable
abrasive particles. A properly maintained, properly operated separa-
tor system can meet the challenge.

Thus, when screening work-mix samples, we are looking at two
things: size distribution of the abrasive particles in the work-mix and
presence of contaminants.

Normally, it suffices to screen the work-mix sample just as it
was obtained, and record the screen analysis. Visual examination of
the various size segments will permit making rough estimates of the
percentage of contamination in each segment (usually found only in
the smallest sizes). Of course, when sand or ceramics are the prin-
cipal contaminant, the percentage can be determined by making mag-
netic separation and weighing the sand, etc. In any case, be sure to
show the percentage of contaminant present. If measuring volumetri-
cally (by graduate), bear in mind that steel abrasive weighs roughly
2 1/2 times as much as sand - and you must compensate accord-
ingly in calculating the percentages.

Remember: Only 2% sand contamination by weight in the total
work-mix is serious—it can cut the normal life of the wheel compo-
nents in half or more.

CONTAMINANTS IN THE SEPARATOR DISCARD SAMPLE

This poses an entirely different problem. Contaminants don’t
belong in the work-mix — they do belong in the separator discard.
That’s the separator’s function. Our only concern with the separator
discard is to determine whether usable abrasive is being discarded.
Undetected loss of usable abrasive through improper separation is
the principal cause of unreasonably high cleaning room costs.

Since all we are concerned with is the presence of abrasive, we
should try to eliminate from the separator discard sample the
obvious contaminants, before screening. This is easy, where sand or
ceramics are involved. Simple magnetic separation permits collect-
ing the abrasive particles for screening. Because the separator dis-
card is supposed to be all contaminants, it usually requires taking a
fairly large sample to permit collecting enough abrasive to screen.
Remember, you are trying to get 25 ML (100 grams), of abrasive
particles only to screen. If you don’t find enough abrasive in the
discard to screen, that’s pretty fair evidence everything is okay... but
don’t kid yourself, as it doesn’t take much abrasive to add up to one
or two pounds per wheel hour.

When oxide scale or other magnetic material is the contami-
nant, checking for abrasive content can be difficult; yet, it’s just as
important to check as it is where sand is involved. Normally, the
oxide scale tends to become so pulverized by the blast stream that
it is found mostly in the extremely fine screen ranges --- as fine or
finer than 80 M, 0.007".

Because, in most cases, abrasive particles finer than 80 M,
0.007" are considered to be of marginal cleaning value, the best way
to handle this is to screen the gross sample over the 0.007" screen,
and discard material below 0.007". Then make up the 25 ML, (100
grams), or 50 ML, (200 grams), sample for screen analysis from
just the material coarser than 80 M, 0.007". Screen this abrasive
portion of the sample using the screens listed in Table 1 to determine
the size distribution of abrasive being discarded. Before calculating
the percentage of usable size abrasive found in the separator
discard, make visual examination under appropriate magnification.
If you find as much or more scale vs. abrasive in the 50 M, 0.0117"
screen, or 40 M, 0.0165" screen, you would discount these
segments; so your final calculation represents the best estimate as to
abrasive content only.

INSTANT CHECK FOR SEPARATOR LOSS OF USABLE ABRASIVE

For INSTANT check at the point of operation, to determine if
usable abrasive is being lost, the use of just two test sieves can
provide the answer in just a few minutes. All that's required is to capture a sample of discard from the separator dribble pipe/flapper valve and drop it on a top screen of 30 M, 0.0234", with a bottom screen of 40 M, 0.3165"—assuming a separator cut-off point of 0.0165"). (Important: Be sure the dribble pipe has its flapper valve in place — always.)

Visual examination of the material resting on the two screens will tell the story immediately. If coarse contaminant (sand or ceramic) is present, use a magnet. Losing a significant amount of abrasive on the 0.0165" cut-off screen merits immediate attention, while loss of material larger than the 30 M, 0.0234" screen can indicate a very serious problem.

If usable abrasive is evident on the screens, a thorough and complete lab analysis is merited. But, this INSTANT check, requiring less than 5 minutes, did its job. It raised an alert!

INSTANT CHECK FOR LOSS OF USABLE ABRASIVE FROM SCALPING SYSTEM AND ABRASIVE TRAP

For INSTANT check at the point of operation to determine if usable abrasive is being lost, the use of just two test sieves can provide the answer in just a few minutes. All that's required is to capture a sample from the coarse refuse discharge and another sample from the expansion trap dribble pipe discharge. Screen both of these samples using the coarsest (X) screen and the finest (X) screen on Table I. Any abrasive passing through the coarse screen and retained on the fine screen is usable material that should be kept in the machine.

Usable abrasive in the coarse refuse discharge indicates a plugged scalping screen. Excessive abrasive flow through the expansion trap discharge indicates a malfunction in the separator system. Both cases require immediate attention. This is true of the expansion trap discharge even though it is being automatically returned to the blast unit. Timed samples at these discharge points will give indication as to the severity of the problem. (If abrasive consumption using a 30 HP wheel should be averaging 15 pounds per wheel hour, for instance, it can be seen that losing two or three pounds per wheel hour via the scalp system or the expansion trap discharge is indeed significant).

A PROPERLY BALANCED WORK-MIX IS THE KEY TO EFFECTIVE AND EFFICIENT BLAST CLEANING

There is no better, no easier way to protect against ineffective, inefficient blast cleaning than to make screen analysis of the work-mix, and the separator discard twice a week. That's a very small investment in time with a big pay-off—constant control of the blast cleaning operation! The same goes for checking discard from the scalp trash chute and the expansion trap discharge!

Whether you decide to go the full ASTM approved procedures, or the short-cut options presented, or a combination of both, remember: the screen analysis obtained is not the end result — it's only the beginning. The pay-off comes only when the screen analysis data is fed back to operations so the operator/maintenance team can do what is necessary to get the work-mix back into balance within the Guideline parameters and then keep it there. ●