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# Project Summary

# A Fluid Sorbent Recycling Device for Industrial Fluid Users

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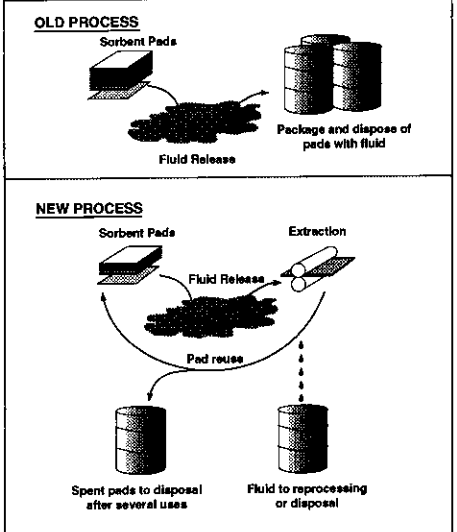


Figure 1.1. SCHEMATIC OF PAD DISPOSAL AND RECYCLE PROCESSES

**This evaluation addresses the product quality, waste reduction, and economic issues involved in recycling fluid sorbent pads. A roller compression Extractor™* that extracts fluids from reusable sorbent pads was evaluated as a method of waste reduction. The extraction device, evaluated for industrial fluid users in New Jersey, was found to be effective in recycling unpleated sorbent pads, especially when used for low-viscosity fluids. The unpleated sorbent pads can be reused at least eight times for low-viscosity fluids and up to three times for medium-viscosity fluids. The Extractor™ cannot, however, be used for pads soaked with high-viscosity fluids. The annual savings in dollars can be substantial: 51% to 75% savings would be possible if pads are reused two and eight times, respectively. The cost per use can be as low as $1.19 for eight reuse cycles, versus $4.80 for single use. The savings come primarily from cost reductions in sorbent pad disposal.**

***This Project Summary was developed by EPA's Risk Reduction Engineering Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).***

## Introduction

The objective of the U.S. Environmental Protection Agency's (EPA) Waste Reduction Innovative Technology Evaluation (WRITE) Program is to evaluate, in a typical workplace environment, examples of prototype technologies having the potential to reduce wastes at the source or to prevent pollution. The goal of this study was to evaluate a technology that extracts fluids such as mineral oils, cutting fluids, and solvents from sorbent pads by roller compression. Specifically, this study evaluated (1) the waste reduction potential of this technology, (2) the quality of the recycled pads, and (3) the economics.

In the process of mixing, handling, and packaging of fluids, spills occasionally occur. At the end-users' sites, the fluids may be spilled or cutting oils splattered during their use in the machining process. Currently, the spilled or splattered fluid is removed by hand with sorbent pads made of melt-blown polypropylene. Workers simply lay the pads over the spilled fluid and mop the spilled areas. Once the pads are saturated with fluid, they are drummed for disposal.

During the evaluation the Extractor™, manufactured by Environmental Management Products, was used to recover the spilled fluid from the saturated sorbent pads. The Extractor™ recovered the fluid by compressing the pads between two gear-driven counter-rotating rollers. The desaturated sorbent pads were then reused several times until the quality of the pads degraded, no longer retaining fluid or providing a clean surface.

The evaluation of the roller compression Extractor™ was performed at Cook's Industrial Lubricants, Inc., in Linden, NJ. Cook's Industrial Inc. is a custom blender

* Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

of industrial lubricants with 450 active formulas on the market. The plant occupies approximately 50,000 $ft^2$ and employs approximately 20 full-time workers.

## Waste Reduction Potential Evaluation

Two types of waste were considered in this study—spent sorbent pads and waste fluid. The current practice is to dispose of the spent pads after one use. The roller compression method extracts the sorbed fluid and permits reuse of the pads. Although the extracted fluid is contaminated with the dirt and debris picked up during the spill, it may be processed for reuse. Therefore, this technology has the possibility of reducing the number of sorbent pads used and the volume of sorbent pads and fluids sent to disposal. Although new pads are not hazardous, the fluid sorbed by them may be. Because the pads take on the characteristics of the sorbed fluid, pad recycling can reduce the volume of hazardous waste disposal.

The extraction efficiency test (ASTM Standard Method F726-81) was used to determine the number of extraction cycles a sorbent pad could endure before becoming unusable due to tearing, deforming, or other general deterioration. The test was also used to examine the rate of decrease in the pads' sorbing capacity (or adsorbency ratio) and the percentage of fluid to be removed by roller compression. Because fluid removal is dependent on the fluid viscosity, tests were conducted with three different fluids covering a range of viscosities.

The average adsorbency ratio and extraction efficiency for low viscosity fluid is plotted against the extraction cycle in Figures 1 and 2. The average adsorbency ratio was 13.99 g to 14.79 g of fluid/g of sorbent pad dry weight (equivalent to 1.44 to 1.48 qt of fluid per full-size pad). The sorbing capacity decreased 18.4% to 21.6% after one extraction cycle and 32.7% to 36.0% after three cycles. No additional decrease was observed up to eight cycles. The percentage of fluid removed by the extraction device (or the extraction efficiency) from the fresh sorbent pads ranged from 82.1% to 83.3%. Subjecting the pads to the Extractor™ for 3 and 7 more cycles resulted in only 3.5% to 4.4% additional reduction in extraction efficiency. After 8 extraction cycles, the pads were compressed, and, in some cases, a thin web of fibers clung to the roller during extraction.

The sorbent pads were also effective for medium-viscosity fluid, as indicated by the adsorbency ratio (17.65 g/g or 1.64 qt per full-size pad) and extraction efficiency (80.8%). After extraction, however, some peeling and slight deformation were observed. The deformation and separation became so severe after the second or third cycle that the pads had to be discarded. The sorbent pads had an adsorbency ratio of 17.83 g/g (or 1.6 qt per full-size pad) for high-viscosity fluid. The fully saturated pads, however, failed to pass through the Extractor™ even at a significantly reduced roller pressure.

## Product Quality Evaluation

The quality of the sorbent pads might be degraded by the extraction process. To determine product quality, both quantitative and qualitative aspects of pad degradation were examined. Degradation of pad quality was quantified using the rate-of-release test (ASTM Standard Method F716-82).

The original test method involved saturating a fresh sample pad with one of the three fluids, weighing it even if still dripping, and hanging it by one corner until dripping stopped. Regardless of fluid types, dripping continued at a rate of 5 to 15 drops per min by the end of 2 hr. Therefore, the reweighing of the pad took place without further waiting. The fluid sorbed per unit dry weight of the pad was re-

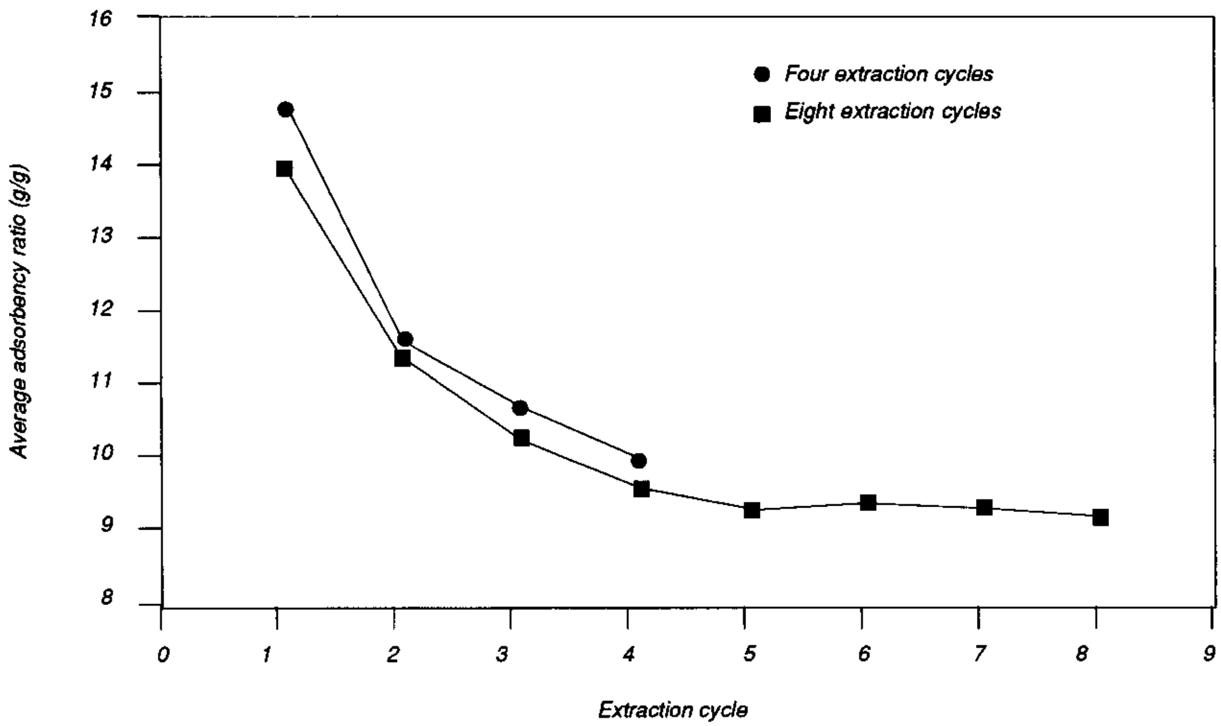


***Figure 1.*** *Adsorbency ratio for low-viscosity fluid.*

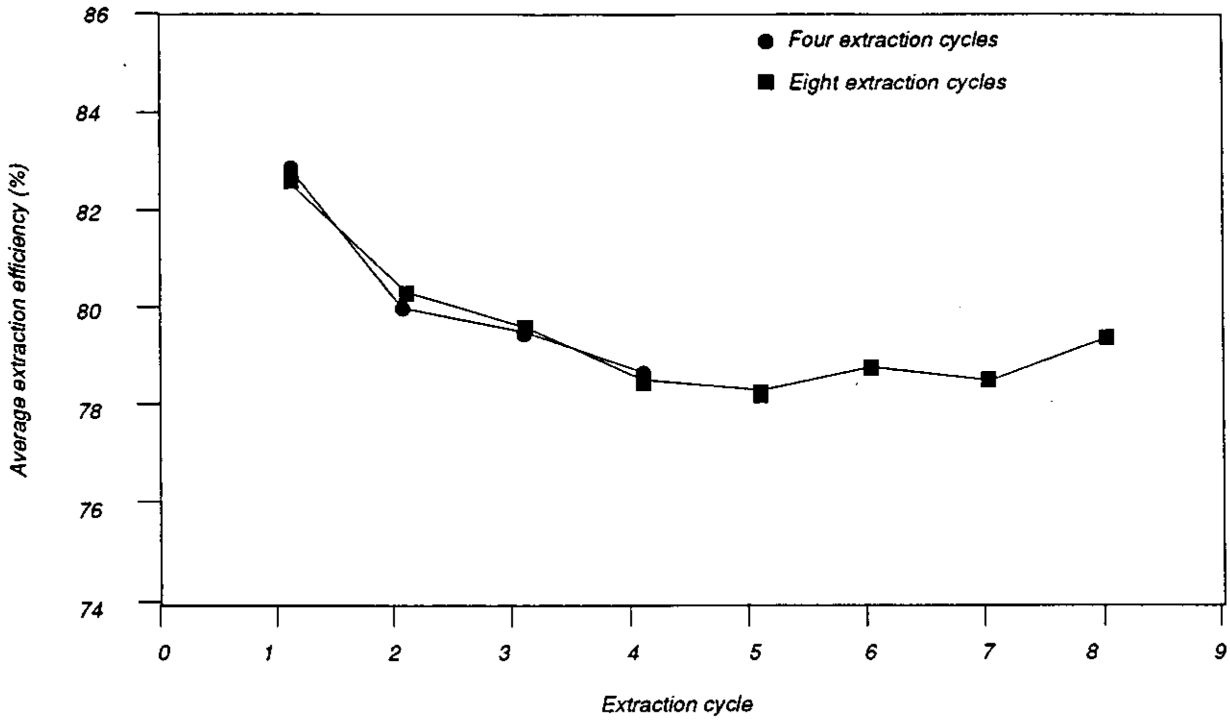


***Figure 2.*** *Extraction efficiency for low-viscosity fluid.*

corded as maximum practical pickup (MPP). The pad was rehung in a well-ventilated area using an electrical fan and weighed at 10-min intervals for 1 hr. (Note: the ASTM Method calls for up to 2 hr of interval weighing; 1 hr was selected for this study.) Again, dripping from the pad continued at a similar rate. The fluid retained at the end of 1 hr was recorded as maximum effective pickup (MEP).

The MPP and MEP of new pads were compared with those of pads that had passed through the Extractor™ four and eight times, respectively. If the used pads had a different rate of release, the test indicated degraded pad performance.

The ability of sorbent pads to leave a clean floor after use was measured by the fluid pickup test. The percentage of pickup by a new pad was compared with that of recycled pads.

The results of the rate-of-release tests are given in Table 1. The MPP and MEP of the fresh pads for the low-viscosity fluid were 6.19 and 5.21 g/g, respectively. The decrease in MPP was 23.6% and 28.9% for pads reused for four and eight times, and the decrease in MEP was 24.8% and 31.1%, respectively. Although the pad performance was degraded by approximately 25% after four uses, the degradation in performance was relatively insignificant for 4 additional uses. For the medium- and high-viscosity fluids, the MPP and MEP were measured only for the fresh sorbent pads.

The results of the fluid pickup tests are presented in Table 2. Regardless of fluid types, the sorbent pads effectively removed fluids from the floor. Only 2.4% to 5.2% of the spilled fluids were left on the floor. Moreover, the sorbent pads effectively removed low- and medium-viscosity fluids even after they were reused four or eight times.

## Economic Evaluation

The objective of comparing costs of pad disposal versus reuse was met by using fluid capacities and process time measured during the study and supplemented by literature and company historical data. For low-viscosity fluid, substantial savings occurred as a result of pad recycling. Savings of up to 51.4% and 75.3% were possible with as few as two and as many as eight reuse cycles, respectively. Additional savings were also possible, but much less significant, as reuse cycles increased to more than eight times. Similarly, the cost per use was greatly reduced, from $4.80 for single use to $1.19 for eight uses (see Figure 3). For medium-viscosity fluid, the annual pad recycling savings were 50.5% and the per use cost was $2.38 for two uses. Additional uses and savings are very unlikely because the sorbent pads became severely separated and deformed as a result of the extraction process. Because the capital cost for the Extractor™ was relatively insignificant ($699) and the annual savings would be substantial, the payback period of the investment would be only 2.8 to 5 weeks.

## Conclusions

The sorbent pad recycling evaluation demonstrated that roller compression technology can be effectively used to extract low- and medium-viscosity fluids from melt-blown polypropylene sorbent pads. The Extractor™ is particularly useful for low-viscosity fluid applications; the sorbent pads can be reused at least eight times. For medium-viscosity fluids, no more than two to three reuse cycles are possible. The potential to reduce waste by recycling sorbent pads can be substantial. For example, for a 1,858-$m^2$ (20,000-$ft^2$) plant, annual sorbent pad consumption can be reduced from 3,600 pads to 1,800 or 450 if the pads can be reused for two or eight times, respectively. Correspondingly, the number of drums for disposal of pads would be reduced from 24 drums (assuming 150 oil-saturated pads per drum) to 6.5 or 1.6 drums (assuming 275 desaturated pads per drum). The 14 to 16 drums of waste fluids extracted from the sorbent pads would be processed for reuse or hauled away for disposal at a waste-to-energy facility.

The sorbent pads exhibited enduring performance to retain and remove low-viscosity fluids after being compressed repeatedly through the Extractor™. The sorbent pads were largely separated and deformed after two (and no more than three) extraction cycles when used for medium-viscosity fluids, however. The sorbent pads soaked with high-viscosity fluids did not pass through the Extractor™ and, therefore, would have to be disposed of after one use.

The recycling of sorbent pads required no additional health and safety procedures, except for those described in the manufacturers' Material Safety Data Sheets (MSDS's) for various fluids.

The economic benefits of the roller compression technology were substantial. The use of the Extractor™ by shops and plants that handle and/or use various oils and fluids would result in annual savings of 51% to 75%. The savings come primarily from the lower disposal costs for spent pads. Further savings may be possible if extracted fluids can be recycled. The per use cost of sorbent pads can be significantly reduced from $4.80 for a single use to $1.19 or less for eight or more reuse cycles.

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***Table 1.*** *Maximum Practical Pickup And Maximum Effective Pickup*

| Pad condition | Fluid viscosity | Pad texture | Pad no. | Fluid sorbed at saturation (g) | Time to "stop" dripping[a] (min) | Maximum effective pickup[b] (g/g) | Time to "stop" dripping[a] with fan on(min) | Maximum effective pickup[c] (g/g) |
|---|---|---|---|---|---|---|---|---|
| Fresh | Low | Unpleated | 1 | 346.54 | 120 | 5.55 | 61.0 | 4.69 |
| | | | 2 | 360.28 | 120 | 6.57 | 61.5 | 5.57 |
| | | | 3 | 350.83 | 120 | 6.45 | 62.0 | 5.37 |
| | | | Average | 352.55 | 120 | 6.19 | 61.5 | 5.21 |
| Extracted four times | Low | Unpleated | 4 | 255.95 | 120 | 4.51 | 60.0 | 3.90 |
| | | | 5 | 203.96 | 120 | 4.62 | 60.0 | 3.75 |
| | | | 6 | 195.71 | 120 | 5.07 | 60.0 | 4.13 |
| | | | Average | 218.54 | 120 | 4.73 | 60.0 | 3.92 |
| Extracted eight times | Low | Unpleated | 7 | 194.06 | >120 | 4.42 | 60.0 | 3.58 |
| | | | 8 | 195.57 | >120 | 4.34 | 60.0 | 3.47 |
| | | | 9 | 197.65 | >120 | 4.45 | 60.0 | 3.58 |
| | | | Average | 195.76 | >120 | 4.40 | 60.0 | 3.54 |
| Fresh | Medium | Unpleated | 10 | 445.65 | >120 | 11.82 | 60.0 | 9.19 |
| | | | 11 | 447.36 | >120 | 11.18 | 60.0 | 8.58 |
| | | | 12 | 452.59 | >120 | 11.75 | 60.0 | 9.36 |
| | | | Average | 448.53 | >120 | 11.58 | 60.0 | 9.04 |
| Fresh | Medium | Pleated | 10B | 306.25 | >120 | 7.78 | 60.0 | 6.86 |
| | | | 11B | 292.09 | >120 | 7.80 | 60.0 | 6.96 |
| | | | 12B | 303.41 | >120 | 7.81 | 60.0 | 6.95 |
| | | | Average | 300.58 | >120 | 7.80 | 60.0 | 6.92 |
| Fresh | High | Unpleated | 19 | 444.54 | 120 | 13.67 | 60.9 | 12.14 |
| | | | 20 | 417.91 | 120 | 13.54 | 60.9 | 12.19 |
| | | | 21 | 392.16 | 120 | 13.68 | 60.9 | 12.38 |
| | | | Average | 418.20 | 120 | 13.63 | 60.9 | 12.24 |

[a] *At the end of the time recorded, dripping continued at a rate of more than 5 to 15 drops/min.*
[b] *Maximum Practical Pickup = Fluid sorbed at the end of 2 hr/sorbent pad dry weight.*
[c] *Maximum Effective Pickup = Fluid sorbed at the end of 1 hr with fan on/sorbent pad dry weight*

**Table 2.** *Fluid Pickup by Sorbent Pads*

| Fluid viscosity | Pad condition | Fluid pickup (%) Replicate no./pad no. 1/28 | 2/29 | 3/30 | Average |
|---|---|---|---|---|---|
| Low | Fresh | 96.4 | 98.2 | 98.2 | 97.6 |
| | 4X[a] | 93.2 | 97.2 | 96.2 | 95.5 |
| | 8X[b] | 94.2 | 95.8 | 95.8 | 95.3 |
| | | 1/31 | 2/32 | 3/33 | |
| Medium[c] | Fresh | 97.1 | 96.2 | 97.5 | 96.9 |
| | 4X | 97.5 | 94.1 | 94.2 | 95.3 |
| | 8X | 95.8 | 93.8 | 99.5 | 94.8[d] |
| | | 1/34 | 2/35 | 3/36 | |
| High | Fresh | 100 | 94.2 | 100 | 98.1 |
| | 4X | N/A | N/A | N/A | N/A |
| | 8X | N/A | N/A | N/A | N/A |

[a] Pad extracted four times.
[b] Pad extracted eight times.
[c] For all medium-viscosity fluid tests, pads were soaked at 50% pad sorbing capacity before extractions.
[d] Based on the performance of Pads No. 31 and 32 only.
N/A = Data not available because pad could not pass through Extractor™.

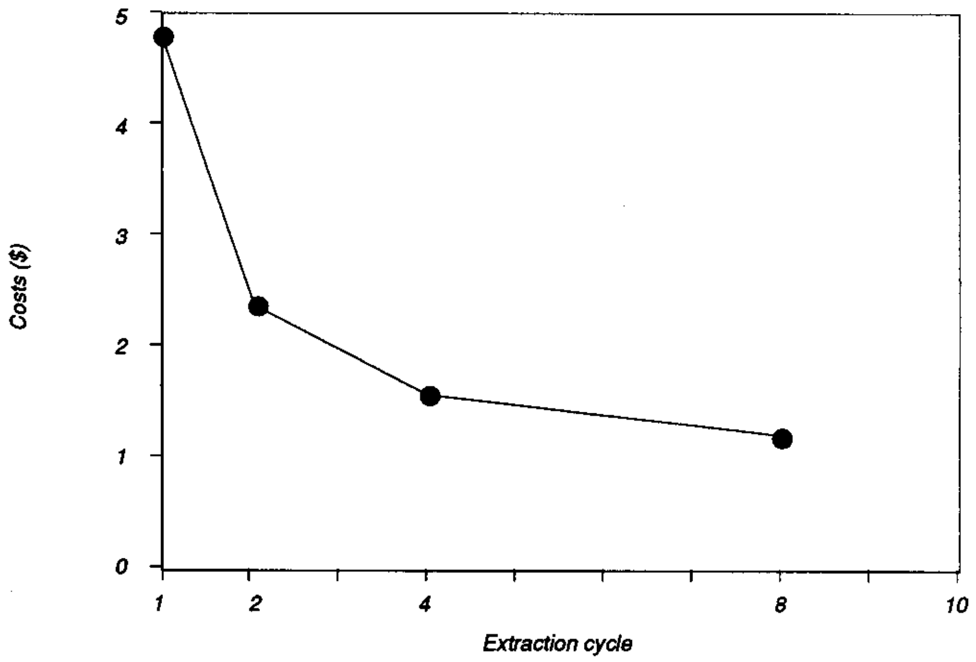


**Figure 3.** *Cost per use for low-viscosity fluid.*



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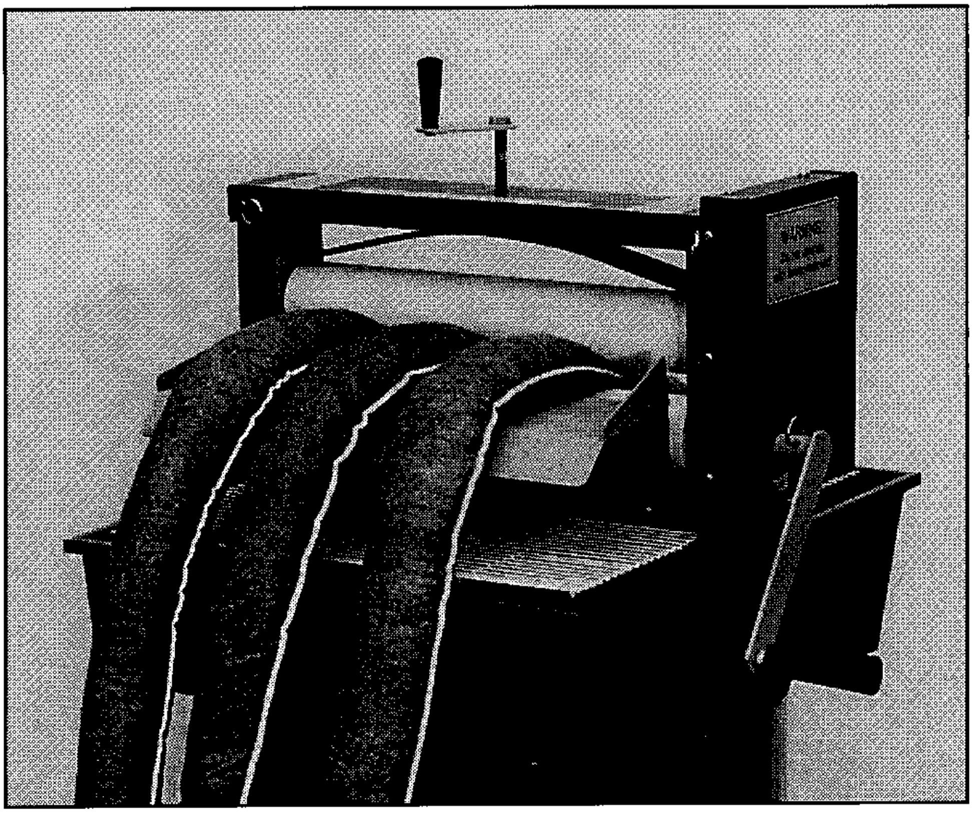
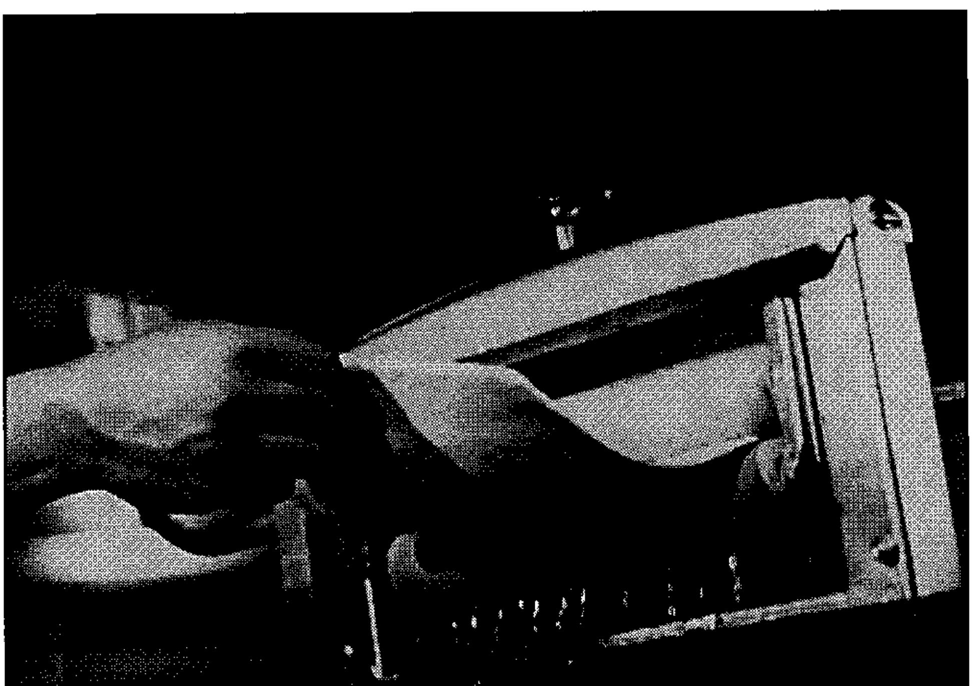


#1500 ***Extractor-Pro*** Oil Extraction System shown running three <u>reusable Mini-Booms</u>. Adjustable roller opening accommodates pads, rugs, socks and booms. Oil flows directly into closed-head 55-gal drum. Optional Motor drive available.



#1000 ***Extractor*** utilizes 55-gal. closed-head drum and comes with built-in anti-spill and anti-overflow valve. The Extractor was the subject of a recently published **EPA *Waste Reduction Innovative Technology Evaluation*** which showed that it extracted at 83% efficiency and that it would pay for itself in 2.8 to 5 weeks based on savings in its use.