REQUEST FOR PROPOSALS

AUTOMATED GRANULAR MATERIAL DISPENSING SYSTEM- ADS

OPPORTUNITY

There are numerous situations which require repetitive processes which if they could be automated would yield improved efficiency and reliability at reduced costs. In order to make such systems available to a wide range of users it is desirable to explore the potential of developing an low-cost, fully-automated system which can provide this capability for a specific application. In the past this process was performed manually. Along with the development of the necessary technology it is imperative that its efficient implementation be in a form suitable for easy operation and inexpensive maintenance.

This project will involve the concept definition, product design study and documentation and finally prototype validation of an automated dispensing system, ADS. A demonstration of the proposed concept feasibility using a "proof-of-concept" prototype will be part of this development project.

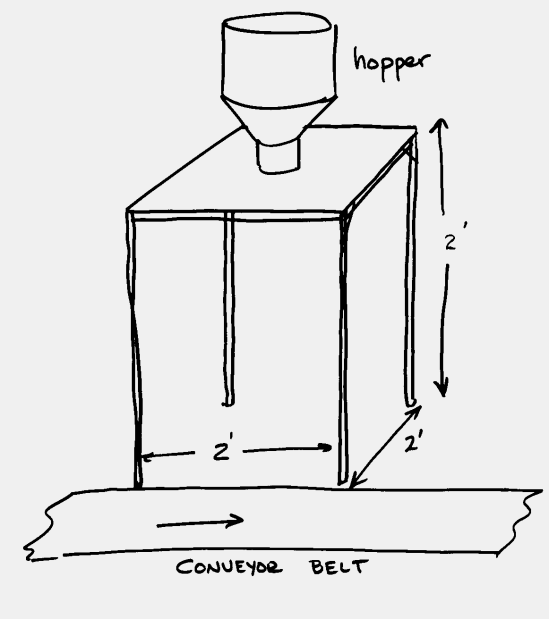
PROJECT REQUIREMENTS: Each design team must:

1. Develop a design for an ADS and document the design in the form of a detailed design proposal. The greatest measure of merit will be associated with meeting all project scheduling and cost goals and demonstrating a robust design. Engineering modeling, performance analysis and simulation of the system and its operation are critical components of the design proposal. The proposal should not only detail the design of the system but must identify the most critical technical, operational and economic factors associated with the design. The results of this project must also be presented in a Critical Design Review.
2. Fabricate a "proof-of-concept" prototype for the system described by the proposal. The prototype must be capable of demonstrating the fully autonomous operation. The prototype will also be used to demonstrate the durability, repairability, portability and storage of the proposed design.
3. Develop a validation test plan and be prepared to demonstrate the operation of the prototype of the ADS on or about December 4, 1998.
4. Follow established procedures for collecting and reporting time spent on the project and cost accounting records for the entire project.

SPECIAL CONSIDERATIONS AND SYSTEM PERFORMANCE REQUIREMENTS:

1. The ADS must be able to fill "nearly cylindrical" containers (dimensions to be provided) with granular, dry material then cap the container and place the capped container upright on moving conveyor belt. The rate at which the system operates should be user selectable over its operating range.
2. The containers are filled by "weight" and that weight should be easily user selectable.
3. The surface of the moving belt is smooth rubber. The belt is 3 inches wide and it moves at a rate of 1 inch/sec.
4. The containers and lids are to be manually loaded in the system in bulk at specified intervals.
5. The system must be completely portable and powered by "on-board" energy sources so that it can be used in situations where normal electric power is not available.

6. The system must be fully contained within a 2 ft (wide)x 2 ft (deep) x 2 ft.(high) cube (the industry standard Model Z1000 Hopper/Conveyor System). The moving belt will translate laterally from left to right (when facing the 2'x2'x2' cube) and be located at the "bottom" - "front" of this region as shown in the sketch below. Containers and lids can only be loaded into the "front face", the product will not be accessible from the top, bottom or "other" three sides.
7. Merit will be defined by the individual design group based upon a recent "customer survey" but consideration should be given to cost, the rate at which the 'cups' can be dispensed, reliability of the system, accessibility and ease of maintenance and energy consumption.
8. The prototype will use a range of different "granular" materials which will be provided. They will range in nominal particle diameter from 0.05 to 0.25 in..
9. The granular material source is a gravity-feed from a hopper through a 2.4 in ID (approx.) PVC tube. The tube is located at the center-top of the 2 ft (wide)x 2 ft (deep) x 2 ft (high) region in which the ADS must be contained.
10. The ADS and all subsystems must be powered with electric or stored mechanical energy sources. No chemical (solid, liquid or gas) sources will be allowed.
11. All electronic components (i.e. motors, servos, computers, wiring, circuit boards, etc.) must be able to be removed from and reinstalled into the prototype system in 30 minutes by two people with manual hand tools only.
12. Since environmental impact is an issue in all product development projects, the "recycle-ability" of the system and the nature of all the proposed fabrication processes will be strongly considered in the product assessment.



SPECIAL CONSIDERATIONS FOR THE PROTOTYPE AND PROOF-OF-CONCEPT DEMONSTRATION

The prototype system for the proof-of-concept demonstration should satisfy the following:

1. Each design team will be provided a Stamp II microprocessor, Serial servo controller (8 channel), a small group of electric motors, a single electronic motor speed controller, 4 servos (3 "small" and one "large"), and selected rechargeable battery packs as well as appropriate manuals for this equipment.
2. Total project costs cannot exceed $400. - this includes $250. provided by ME470, Inc. and up to $150. from the design team. This cost includes all out-sourced parts, raw materials, tools, administrative costs(copying, viewgraphs, etc.) and expendable supplies(glue, wire, etc.).
3. Component parts can be either fabricated in-house or purchased from outside vendors (out-sourced). All out-sourced parts must be accounted for in the overall cost at their full retail value. Groups cannot "out-source" fabrication processes.
4. All "in-house" parts must be fabricated by the design team using the facilities provided in B19, Fitzpatrick Hall.
5. The completed prototype and all "scrap" materials are the property of the AME department.

CURRENT PROCESS AND CAPABILITIES

Currently a variety of granular materials are packaged using the industry standard Model Z1000 Hopper/Conveyor System. This is accomplished in a manual fashion with using a single worker who operates a manual "valve" attached to the Model Z1000. This approach requires the worker to "weigh" each container then attach the cap and place the container on the conveyor belt. Current practice indicates that an experienced worker can process materials at rate of 6 per minute when working 45 minutes an hour (5 min. breaks every 15 min). The filling and weighing process can be performed with a tolerance of ± 6% of the container weight. This is a tedious, repetitive process prone to operator error. There are also numerous applications in which the operator is exposed to dust particles from the granular material which can create health hazards with extended exposure.

Initial and operating costs should demonstrate a capability which would be competitive with a minimum wage worker performing the filling operation and that worker would be replaced by an individual who would monitor the operation of a series of these machines.

Customer Survey

ME470 Inc. is embarking on a new product development venture and since you are a user of "granular material" packing equipment we appreciate your willingness participate in this survey. We ask that you provide your perspective on your requirements for this type of product. Your responses will be used to help us in this new development effort. We intend to develop this product to be compatible with the industry standard Model Z1000 Hopper/Conveyor System and package a range of granular materials in the standard Model A1 distribution container/lid product. In order to provide a new and innovative product we also plan that this new design be completely portable and not require any external power sources. Please circle your response to each of the following.

1. What would be your desired maximum through-put rate for this device (containers per minute)?

2 4 6 8 10 12

2. How frequently would you like to be required to restock containers/lids in the packaging system (minutes) when packaging at the maximum rate?

2 4 6 8 10 12

3. What maximum weight would you consider to be acceptable for this product (lb)?

5 10 15 20 25 >25

4. How long would you require a fully portable unit to be able to operate (min)?

15 30 45 60 75 >75

4. What would you consider an acceptable installation time into the Model Z1000 (min)?

<1 1 3 5 >5

5. Do you consider spillage of the material to be:

1 2 3 4 5

acceptable absolutely unacceptable

6. Do you rate internal access for cleaning:

1 2 3 4 5

not very important critical

7. Do you rate internal access for maintenance:

1 2 3 4 5

not very important critical

8. Do you rate ease in filling with empty containers and lids:

1 2 3 4 5

not very important critical

9. Please rank following features in order of importance to you:

small number of moving parts, operator safety, reliability, cost, maximum packaging capacity, operating cleanliness, required maintenance, ability for user to replace parts

Customer Survey Results

A sample of 100 potential customers responded to our survey. The following summarizes their responses.

1. What would be your desired maximum through-put rate for this device (containers per minute)?
2 (8%) 4(16%) 6(42%) 8(21%) 10(10%) 12(3%)

2. How frequently would you like to be required to restock containers/lids in the packaging system (minutes) when packaging at the maximum rate?
2(0%) 4(25%) 6(25%) 8(40%) 10(0%) 12(10%)

3. What maximum weight would you consider to be acceptable for this product (lb)?
5(0%) 10(33%) 15(60%) 20(7%) 25(0%) >25(0%)

4. How long would you require a fully portable unit to be able to operate (min)?
15(10%) 30(55%) 45(25%) 60(0%) 75(10%) >75(0%)

4. What would you consider an acceptable installation time into the Model Z1000 (min)?
<1(15%) 1(22%) 3(60%) 5(3%) >5(0%)

5. Do you consider spillage of the material to be:
1(0%) 2(12%) 3(25%) 4(58%) 5(5%)
acceptable absolutely unacceptable

6. Do you rate internal access for cleaning:
1(0%) 2(0%) 3(5%) 4(12%) 5(83%)
not very important critical

7. Do you rate internal access for maintenance:
1(0%) 2(0%) 3(8%) 4(12%) 5(80%)
not very important critical

8. Do you rate ease in filling with empty containers and lids:
1(3%) 2(10%) 3(43%) 4(31%) 5(13%)
not very important critical

item	times #1	times #2	times #3	times #4	
number of parts		4	12	16	32
operator safety		2	3	14	19
reliability	30	24	23	5	82
cost	43	33	17	3	96
maximum capacity	27	18	16	11	72
cleanliness		9	12	31	52
maintenance		8	14	11	33
part replacement		2	3	9	14
total	100	100	100	100	