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EFFECTIVE INDUSTRIAL FINISHING SYSTEMS DESIGN UTILIZING SIMULATION TECHNIQUES

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ABSTRACT

The use of simulation techniques in designing a fiberglass hood paint system is demonstrated. Two alternate designs are described and analyzed as to float requirements. Due to schedule considerations in maintaining job sequence, the first design was determined impractical. The results of both analyses will be presented in the conference session.

INTRODUCTION

With an ever increasing demand for its conventional size pickup trucks and a confirmed business objective of consistantly improving the quality of their products, General Motors Truck & Bus Group has initiated a project that will not only meet that demand, but will also improve performance on two of their present assembly lines. The two current lines are the medium duty trucks, produced in Plant #6 and the heavy duty Brigadier, General, and Astro produced in Plant #2. Both of these plants are a part of the Pontiac, Michigan complex.

The new truck project will capitalize on the state of the art in industrial welding, finishing, material handling, and assembly technology to maintain and surpass the current high quality levels maintained. These and many other innovations are being designed into three production facilities that will meet the demands for pickups with a world class product. One of the three facilities is the existing Plant #6, which requires the movement of the medium duty assembly processes to Plant #2. This movement capitalizes on utilizing existing facilities on the medium and heavy duty lines, and improves production efficiencies.

As the facility design process evolved, several innovations were incorporated, one of which included a consolidation of the paint systems for the medium and heavy duty fiberglass hoods. The combining of the finishing systems required would substantially reduce the costs involved, and save on floor space in Plant #2. The cost of effective industrial finishing systems is high, as special precautions are necessary to maintain paint quality, safety, and environmental requirements.

The concept developed for the fiberglass hood assembly included the capability of recirculating tutone and tritone hoods, as well as repairs through the same paint and assembly system. This seemed very efficient and cost effective, however a simulation study of the concept was requested which would allow an analysis of two alternate designs for operating this system.

SIMULATION OBJECTIVES

The main objective of the simulation project was to evaluate the float requirements both ahead of the hood spray booth and ahead of the two assembly lines. The scheduled sequence of tutones and tritones was assumed to be random, as well as occurances of system downtime and jobs requiring repair, which generated concern on the size of the three conveyor segments identified. As the system is supplying hoods which are built to a pre-determined build sequence for the medium and heavy duty assembly lines, that sequence must be maintained out of the system. Two approaches to maintaining build sequence were designed. The simulation project objectives included the evaluation of each of these.

SYSTEM DESCRIPTION - FIRST DESIGN

A schematic of the system processes as simulated, is provided in Figure 1 to assist in the description that follows. It should be noted that the process description is not complete, as a more simplified flow was utilized in the simulation analysis.

Both medium and heavy duty hoods are loaded onto an inverted power and free conveyor, which carries them to a high pressure washer. The washer removes surface dirt that has accumulated on the hoods in transit from the manufacturer. Hoods(which will be referred to as jobs)are then accumulated on a conveyor segment leading to the electrostatic spray booth. As the first design of this entire system dictated that completed tutone and tritone jobs must be in build sequence upon entry to the spray booth, a decision as to job sequences is made at the end of the accumulator. An exception to this is the repaired hoods, which are given top priority on re-entry, and re-sequenced at a later time.

When the appropriate job has completed the paint process, it then is conveyed through a radiant and a convection oven, followed by an inspection station. Hoods are then sprayed black in the grill area and conveyed to one of two areas. Tritones are sent to a masking area, to reenter the spray booth. Tutones and repairs are sent to a separate masking area, to reenter the spray booth. Completed jobs are sent to a hood build delivery conveyor, which splits into two segments to allow repaired jobs to be re-sequenced. Trim is then added to the hoods, and they are conveyed to the appropriate assembly line in build sequence.

RESULTS - FIRST DESIGN

The system, as described, was simulated using the Siman simulation program. The analysis indicated that one of two alternate modifications would be necessary to operate the first design alternative simulated. This conclusion is supported by the amount of time necessary to maintain job sequence at the spray booth entry location. The first modification possible, but expensive, was the addition of an on-line scheduling system that would enable a more accurate initial schedule for the fiberglass area. The second modification possible was not feasible as it implied an overtime situation and increased storage requirements in all three locations identified in the objectives. This indicated that the first design, although less costly than the second, was not a satisfactory concept.

SYSTEM DESCRIPTION - SECOND DESIGN

The second design is a slight modification of the first, as illustrated in the system schematic in Figure 2. The difference from the first design is the area previously dedicated to resequencing repairs. The second design allows for a resequencing of tutone and tritone hoods, as well as repairs with a resequencing spur and a mix loop. This requires a more sophisticated control scheme than the first design, however, it should eliminate the inefficiencies that were anticipated when requiring the job sequence to be maintained upon entry to the spray booth.

RESULTS - SECOND DESIGN

As the analysis of this design was still in progress at the time this paper was submitted for inclusion in the proceedings, the results are not included. The results will be discussed at the conference, however, it is anticipated that this design will prove to be the most efficient alternative.

CONCLUSION

This paper, and the analysis described, has illustrated how effective simulation techniques can be applied in automotive facility design. Continued utilization of these techniques is vital for survival in today's competitive marketplace.

SYSTEM SCHEMATIC
FIRST DESIGN

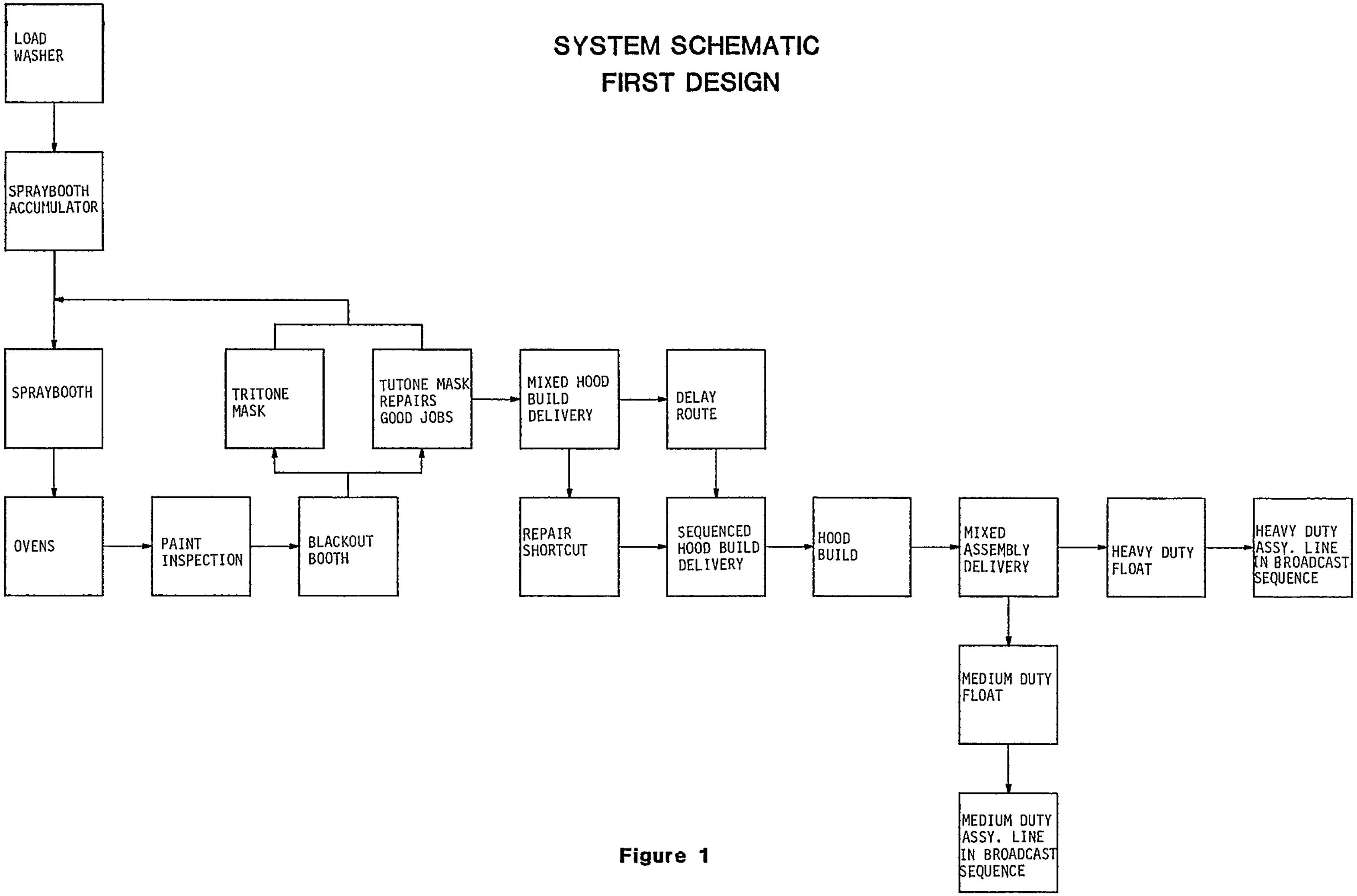

Figure 1

SYSTEM SCHEMATIC
SECOND DESIGN

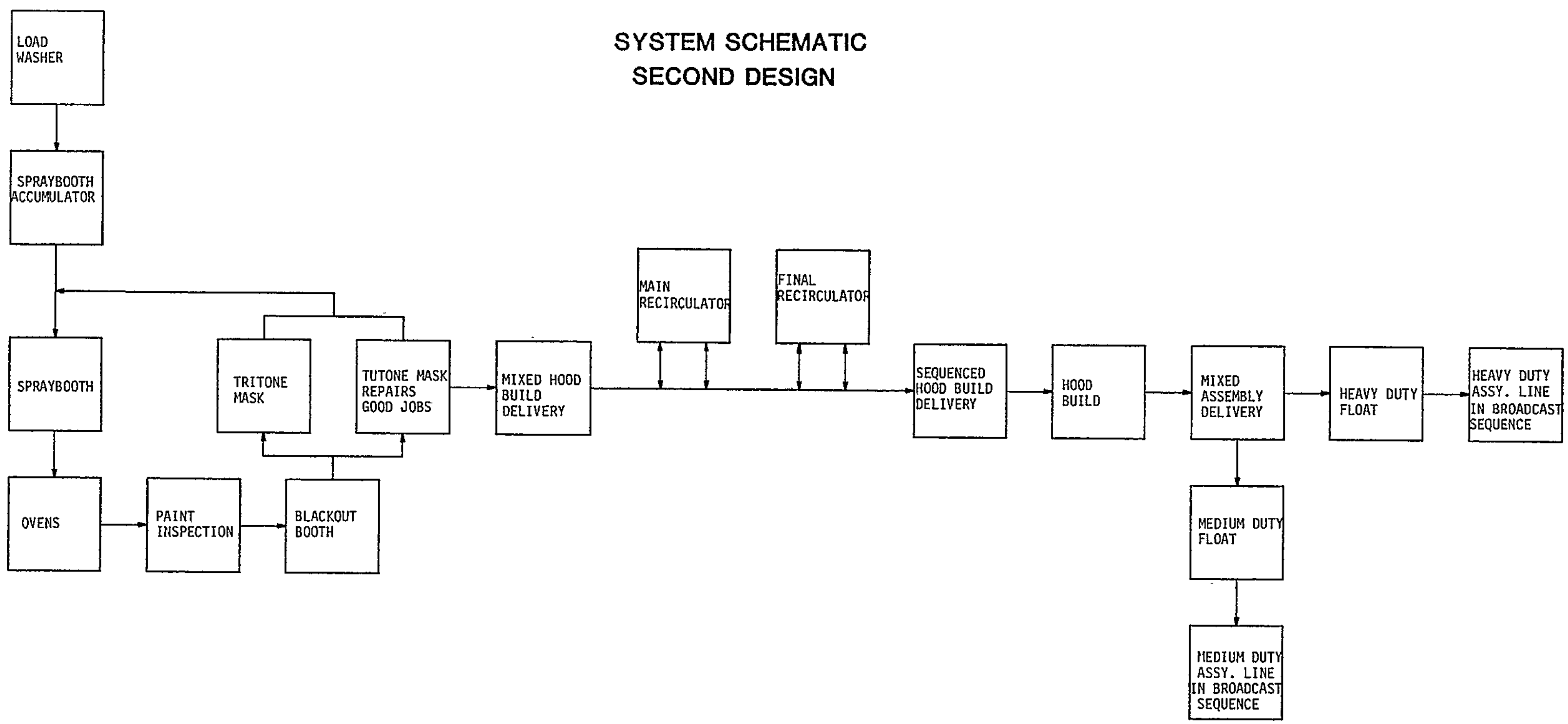

Figure 2