

# 다기능 내부 회전 코어가 장착된 SPC 파이프 제조기계의 설계

## Design of sulfur concrete pipe making machine having multifunctional inner rotating core

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### 1. Introduction

Sulfur concrete is a thermoplastic material prepared by hot-mixing sulfur cements and mineral aggregates. By using sulfur cement binders and aggregates that are not attacked by many mineral acid and salt solutions, high strength corrosion-resistant sulfur concrete can be produced for use in certain applications where other construction materials deteriorate rapidly. Sulfur concretes exhibits excellent performance in many acidic and salt environments. Due to this fact this material is used for making drain pipes where acidic and salty solution level is high. In this research SPC pipe machine is designed to manufacture drain pipes for overcoming the low performance existing pipes.

### 2. Description of problem

Corrosion of concrete sewer pipe is an existing problem that faces sewer systems all over the world. Corrosion in sewage pipes leads to costly replacement of concrete structures. The machines used now days to make pipes are mostly horizontal type. Those machines are making products of non-uniform thickness and material variation is not evenly distributed throughout the product. Small cracks can also be seen resulting low strength and less durable product. To overcome all those problems there is a solution of using SPC which can't be affected by the acidic contamination and which have high strength as well as durability more than

conventional concrete. The manufacturing process will be altered using casting technology using vertical centrifugal vibration instead of horizontal centrifugal force to improve the physical strength of product.

### 3. Design Procedure

In order to develop the high quality pipe, systematic procedure is developed, at first all the required parameters are taken and conceptual designs are developed. Design of inner core is highly focused to solve multiple functions i.e. conveying, mixing and pressing the concrete for giving the size in the circular pattern. TRIZ methodology is employed to assist the way to get new models which in turn used to resolve the encountered problems of old machine. Concept design is aimed to give number of reliable models that satisfies the requirements. Conceptual model generation is based on the TRIZ design parameters which are focused in manufacturability of machine, durability, reliability and shape of product<sup>[1]</sup>. Number of patents and TRIZ technology is studied to avoid the patents and to generate robust conceptual design. Solution of crack generation is also considered as an important factor during conceptual design where the functionality of machine is described also in Fig.1.

Based on the inventive principles of TRIZ each conceptual design is focused for maximizing efficient production of pipe. According to principle 14

(Spheroidality) all concepts are modeled to give rotational movement with centrifugal force circulating plastic concrete on equal proportion at every parts for mixing. Principle 18 (Mechanical vibration) is also considered to perform compaction of concrete where the vibration is provided by centrifugal vibration motors. This function removes the air-voids and makes the pipe durable. Principle 2(Extraction) is considered to remove noise in consideration of old machine; old machine spins at very fast making noisy atmosphere therefore new designs are created to move at slower speeds with better functionality. Principle 4 (Asymmetry) is considered because the product to be designed is circular therefore machine will be symmetric to give the stable design. By considering those factors five concepts are generated via CAD model where each machine satisfies the design requirement.

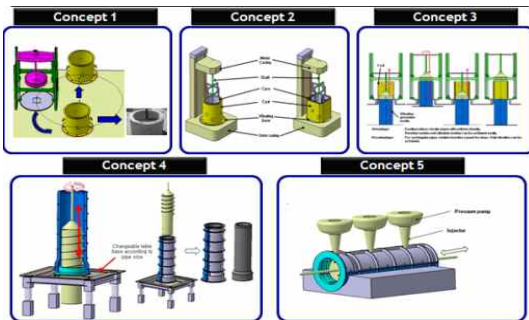


Fig. 1 Conceptual design of concrete pipe making machines

The difference between the five generated concepts are in concept 1 inner die is small and light design is given for high priority. In concept 2 both inner and outer die rotates simultaneously for making compact product. In concept 3 vibration are given from inside of inner die which rotates to form strong and durable pipe. In concept 4 inner die performs the function of conveying, mixing and compressing and in addition vibration is given from motor attached beneath the table. In concept 5 the inner rotating core compacts concrete forcibly injected by pressurized injector attached with the inner die.

Best and feasible design is selected from the

number of conceptual solutions mentioned in Fig.1. Design selection is based with the different design selecting methods and intensive discussion with the customer. Concept scoring technique is used to select best model from the generated designs. Then concept 4 gets the highest score comparing with the all model so it is implemented further. After the selection of best conceptual design, detail design for the selected model is carried out.

#### 4. Conclusion

A systematic development of the SPC pipe making machine was presented in order to realize strong and durable pipe which can cope up with acidic environment for a long period of time. This research proposed a new concept of SPC pipe molding machine having inner core that performs multifarious work i.e. conveying, mixing, compacting and surface finishing during production of concrete pipes. The proposed SPC molding machine can enhance the durability and increase the performance of storage tanks. Due to the new design concept and proper design process the proposed design can be a milestone to satisfy the requirement of the pipe manufacturing companies. Future research will be focused to perform topology and shape optimization of the main components of designed SPC molding machine.

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