Wet mix and dry mix concrete: cost and quality

This is a conceptual proposal in which the main objective is to determine the cost and quality effectiveness on the application of modular wet mix and dry mix concrete batching plant. Based on the data collected over the pass years, a detail study was being conducted to determine the various cost factors arising from the setting up of concrete batching plant, production operations, quality control, inventory and delivery of the products to the customers. As this study covers the entire overall operations of a commercial concrete batching plant, the complexity of the various processes and functionalities has to be identified to provide a full understanding on the limitations on the speed, cost, quality, flexibility and dependability.

This proposal is also inline with the company long term strategy of increasing the marketing share by twenty percent annual growth. Therefore, to achieve this goal, various steps have to be taken into consideration such as the speed, cost, quality, flexibility and dependability.

Existing Dry Mix Concrete Batch Plant

Plant Component

The basic components of dry mix concrete batch plant and its related facilities are as tabulated below:-

Item

Descriptions

Remarks

1

Ground Hopper

For feeding of raw material, coarse and fine aggregates

2

Movable Inclined Conveyor

To convey the coarse and fine aggregate to the designated storage compartment

3

Aggregate Storage Bin

For storage on top of the aggregate weighing bin

4

Aggregate Weighing Bin

For weighing of the coarse and fine aggregates

5

Shooting Conveyor

To convey the coarse and fine aggregates at high speed which shoot directly into the mixer drum of the mixer truck

6

Cement Storage Silos

For storage of cement – OPC, PFA and Slag Cement

7

Cement Weighing Bin

For weighing of various cement

8

Water Weighing Bin

For weighing of water

9

Admixtures Weighing Bin

For weighing of admixtures

10

Control Room

To provide staff on the control of the production

11

Water Storage Tank

For water storage

12

Aggregate Stockpile

For storage of coarse and fine aggregates

13

Slump Check Platform

For concrete slump check

14

Wheel Loader

For material handling from aggregate stockpiles to ground hopper

15

Mixer Truck

For mixing of concrete and delivery of finished products to customers

16

QC Laboratory

For quality control and testing

17

Power Supply

To provide power supply to the plants and other facilities either by TNB or generator set

18

Waste Material Storage

To collect all waste material and disposed to designated area

Figure 1 in the Appendix shows a typical dry mix concrete batch plant layout. The ideal size for setting up is plant is 2, 950m2, this set up will include a laboratory for quality control, a site office for staff and other facilities such as workshop and weighbridge on material control.

Process Flow of Dry Mix Plant

The process flow of the entire dry mix plant operation per 8 m3 load is as illustrated below:-

Cycle Time per Load = Batching + Mixing & Slump Check + Delivery + Discharging + Return + Queuing

= 5 min + 15 min + 30 min + 45 min + 30 min + 10 min

= 135 min

From the process flow mapping, it is clearly shown that the complete process cycle time for 8 m3 load is 135 minutes. As the plant capacity is 80m3/hour, if the efficiency of the plant is 80%, therefore the plant is capable of producing 8 loads of 8m3-load but all the rest of the processes are done by the mixer trucks from mixing to discharging at site. In order to have a smooth operation flow, the number of mixer truck required by this dry mix plant is calculated as below:

Number of Mixer Truck = 135/60X8

= 18

From the calculation above, 18 units of mixer truck is required for the smooth operation.

Quality of the Product

In dry mix plant, all the pre-determined materials are charged into the mixer drum of the mixer truck, then the mixing and quality check are carried out by the individual mixer truck operator accordingly. The product quality is not consistent as this is done by the 18 mixer truck operators and therefore, quality is becoming a major issue in this type of plant as the requirement of the quality is increasing with the advancement in construction technology. This quality will also hinder the further penetration of market share and jeopardise in achieving the long term strategic goal.

Cost

This operating cost is only covering all the facilities except the raw material cost as this remains consistent either dry mix or wet mix plant. But there are other costs that everyone is aware of such as the maintenance cost of the mixer truck. In this case, the operating cost of the plant is cheap but the mixer truck is much higher as there are 18 units of mixer drums which are having high wear and tear parts as they are used for mixing the concrete. These costs will be tabulated in the comparison and the overall operating cost will be identified.

Flexibility

In term of flexibility, this dry mix plant will have a limitation in producing high grade concrete as the mixing is done by mixer truck. The mixer truck will not be able to mix consistently and thoroughly inside the mixer drum of the mixer truck as the mixing is only dependent on the ploughing and dropping action of the mixer blade on the side wall of the mixer drum. Other than this, it is the same as in other type of plants.

Dependability

The availability, reliability and maintainability of this plant is actually quite similar to the other types of plant available in the market but duration for each maintenance will be a little bit shorter than wet mix plant because the components is less and the mixing is transferred to the mixer truck, therefore the availability is better. The reason for this is, there are 18 units of mixer instead of 1 unit of mixer.

Proposed Modular Wet Mix Plant

Basic Plant Components

The basic components of dry mix concrete batch plant and its related facilities are as tabulated below:-

Item

Descriptions

Remarks

1

Ground Hopper

For feeding of raw material, coarse and fine aggregates

2

Aggregate Weighing Bin

For weighing of various types of aggregates

3

Horizontal Conveyor

To convey the weighed coarse and fine aggregates to Inclined Conveyor

4

Inclined Conveyor

To convey the weighed coarse and fine aggregates to the aggregate transfer bin

5

Aggregate Transfer Bin

For storage on top of the Mixer

6

Mixer

For mixing of concrete

7

Concrete Holding Hopper

For holding of finished product before discharging into mixer truck

8

Cement Storage Silos

For storage of cement – OPC, PFA and Slag Cement

9

Cement Weighing Bin

For weighing of various cement

10

Water Weighing Bin

For weighing of water

11

Admixtures Weighing Bin

For weighing of admixtures

12

Control Room

To provide staff on the control of the production

13

Water Storage Tank

For water storage

14

Aggregate Stockpile

For storage of coarse and fine aggregates

15

Wheel Loader

For material handling from aggregate stockpiles to ground hopper

16

Mixer Truck

For mixing of concrete and delivery of finished products to customers

17

QC Laboratory

For quality control and testing

18

Power Supply

To provide power supply to the plants and other facilities either by TNB or generator set

19

Waste Material Storage

To collect all waste material and disposed to designated area

Figure 2 in the Appendix shows a typical modular wet mix concrete batch plant layout. The ideal size for setting up is also plant is 2, 950m2, this set up will include a laboratory for quality control, a site office for staff and other facilities such as workshop and weighbridge on material control.

Process Flow of Modular Wet Mix Plant

The process flow of the entire modular wet mix plant operation per 8 m3 load is as illustrated below:-

Cycle Time per 8 m3Load = Batching + Delivery + Discharging + Return + Queuing

= 5 min + 30 min + 45 min + 30 min + 10 min

= 120 min

From the process flow mapping, it is clearly shown that the complete process cycle time for 8 m3 load is 120 minutes. As the plant capacity is 80m3/hour, if the efficiency of the plant is 80%, therefore the plant is capable of producing 8 loads of 8m3-load in just 5 minutes as the process of mixing is

done by the mixer and mixer truck is only used for delivery and discharging at site. In order to have a smooth operation flow, the number of mixer truck required by this dry mix plant is calculated as below:

Number of Mixer Truck = 120/60X8

= 16

From the calculation above, 16 units of mixer truck is required for the smooth operation.

Comparison of Process Flow

Item

Descriptions

Dry Mix Plant

Wet Mix Plant

1

Batching

5 minutes

5 minutes

(Mixing by Mixer)

2

Mixing

15 minutes

(By Mixer Truck)

3

Delivery to Site

30 minutes

30 minutes

4

Discharging at Site

45 minutes

45 minutes

5

Return to Plant

30 minutes

30 minutes

6

Queuing at Plant

10 minutes

10 minutes

7

Total Cycle Time per Load

135 minutes

120 minutes

8

Mixer Truck Required

18

16

By looking at the table above, it is clearly shown that the cycle time per load is reduced by 15 minutes or 11%. The number of mixer truck required to complete the work in progress is also reduced by 2 units, there will be a significant improvement in the whole process flow and this will be reflected in the investment cost and operating cost later.

Quality of the Product

In wet mix plant, all the weighed materials are charged into the mixer of the mixer for mixing and quality check are controlled by the batching operator accordingly of which the product quality is consistent therefore, quality issues can be minimized in this type of plant as the requirement of the quality can be assured to fulfil the modern construction technology. This quality assurance will also help increase the image and market recognition

thus, to further penetrate into the untapped market share and also in achieving the long term strategic goal.

Cost

This operating cost is only covering all the facilities except the raw material cost as this remains consistent either dry mix or wet mix plant. Tabulated on the next page is the comparison of the overall operating cost of the whole process flow. It can be shown that the overall operating cost is reduced by RM1. 26/m3 or 7. 2% and it is very significant and substantial as the annual production is huge. For example, an annual production of 1 million cubic meters will mean a saving of RM1. 26 million and so on and so forth, thus increasing the profitability of the sales and competency in the market place.

Comparison on Wet and Dry Mix Plant Operational Cost excluding Raw Material

Flexibility

In term of flexibility, the wet mix plant will have less limitation in producing high grade concrete as the mixing is done by mixer. The mixer will be able to mix consistently and thoroughly inside the mixer as the mixer is specially design for this specific purpose. It can also produce different types of design mix as required by customers. Another advantage is that the supply radius can be increased by 5 km, thus the coverage area.

Dependability

The availability, reliability and maintainability of this plant is actually quite similar to the other types of plant available in the market and the duration for each maintenance will be a little bit longer than dry mix plant because

the components is more, therefore the availability is slightly less but this can be eliminated by pre-planned preventive maintenance.

Conclusion

With the study and experience that had been merged and input, it is strongly advisable to convert all the dry mix plant into the modular wet mix plant for the following reasons:-

Cheaper operating cost as justified on the operating cost

Better flexibility for high grade concrete

Less mixer truck requirement

Quality consistency and assurance

All the above implementations will be justifiable to achieve the company long term strategy to provide the highest quality, service at the lowest cost and to increase the market share in the next 10 year.